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GERMINATION SPECIALITIES OF SOME SALINE PLANT SPECIES

KÁROLY ECSERI[1], ILDIKÓ KOHUT[2], ZSUZSANNA TÚRINÉ FARKAS[1], ISTVÁN DÁNIEL MOSONYI[2], ANDREA TILLYNÉ MÁNDY[2]

[1]John von Neumann University, Faculty of Horticulture and Rural Development, Hungary
ecseri.karoly@kvk.uni-neumenn.hu
[2]Szent István University, Faculty of Horticultural Science, Hungary
mandy.andrea@kertk.szie.hu

ABSTRACT
Seeds of *Achillea aspleniifolia*, *Artemisia santonicum*, *Aster tripolium* subsp. *pannonicum*, *Inula britannica*, *Limonium gmellinii* subsp. *hungaricum* and *Podospermum canum* were collected from five different sodic habitats in Hungary: Apajpuszta, Cegléd, Dinnyés, Farmos and Fülöpszállás. We compared the germination percentage and rate among the populations and determined the optimal sowing depth and substrate preference. We observed big differences among the species and even the habitats. Outstanding dynamics was measured for *Achillea aspleniifolia* and *Artemisia santonicum* species. Highest germination percentage was reached by *Podospermum canum*. Germination stress-tolerance index was the highest for *Podospermum canum*, while the lowest was determined for *Inula britannica.* The germination rate of the species did not reach the volumes reported in the publications. The majority of species germinated in light, optimal substrate was seedling growing medium. *Podospermum canum* proved to be a highly stress-tolerant species.

Keywords: sodic, saline, promptness index, germination stress-tolerance index

INTRODUCTION

More than 12,000 km^2 of different types of sodic soil surfaces are present in Hungary (TÓTH AND SZENDREI, 2006). Their flora is excessively rich in perennial species that even have ornamental value. This ornamental treasure of us is largely untapped. Most of the sodic perennial species tolerate well but do not demand obligatorily the high salinity concentration and bad structure of the soil, intensive insolation and dryness (BORHIDI, 2007). The selection for salinity tolerance and examination of salinity tolerance of ornamental plants is going on in other countries as well (KRATSCH ET AL., 2008).
The first step in selection is collecting data and samples *in situ,* and the examination of generative propagation organs. LUDEWIG ET AL. (2014) reported high (76-94%) viability and germination ability of *Inula britannica*. The germination percentage of *Achillea millefolium* ssp. *elburensis* was over 60% between 15 °C and 30 °C, BANNAJAN ET AL. (2006) found 20 °C optimal. Based on publication data, *Aster tripolium* seeds germinate over 90% on 25/15 °C (BAKKER AND DE VRIES 1992). WANG AND LI (2012) measured 98% germination percentage for *Limonium gmellinii*. PETI ET AL. (2015) reported 85% germination rate of *Podospermum canum*.
During our experiment, we examined the germination ability of some saline perennial species derived from different habitats. Furthermore, we determined the effect of sowing depth and sowing substrate on germination.

MATERIAL AND METHOD

Comparison of populations based on germination parameters

We collected seeds of *Achillea aspleniifolia, Artemisia santonicum, Aster tripolium* ssp. *pannonicum, Inula britannica, Limonium gmellinii* ssp. *hungaricum* and *Podospermum*

canum species from five different salty-sodic habitats in Hungary in October-November 2017: Apajpuszta, border of Cegléd, region of Dinnyés, region of Farmos railway station, and region of Fülöpszállás (Not all species were found in all habitats). Seeds were stored at room temperature. We sowed the seeds on 05.01.2018 in the greenhouse of the Szent István University, Buda Campus into 0.7 litre plastic boxes. Sowing substrate was the mixture of Klassmann peat TS-3 and 2 g/l Futor (carbonated lime). Fifty-five seeds were put into each box that was covered with a clear topper. Boxes were put on basic heating (6-8 °C higher than air temperature) tables till the start of germination. We counted the seedlings every 3-4 days. We considered the germination as finished on 12.02.2018. We want to repeat the experiment at the end of 2019.

Examination of optimal sowing depth

In this experiment, we used seed mixtures of propagules derived from different salty-sodic habitats, stored on room temperature. Every mixture contained 50 seeds. *Podospermum canum* mixture contained 10 seeds. They were sown into 750 ml Swedish boxes half filled with Klassmann TS-3 peat on 24.01.2018. We sowed the seeds of all the six taxa at three different depths:

- on the surface of the substrate (examination of germination on light)
- 1 mm cover with substrate
- 5 mm cover with substrate

Covering material was also sifted Klassmann substrate. After humidifying, sowing boxes were closed and labelled and were placed on rolling tables in a plastic tunnel. Air temperature was 20 °C, heating tubes were located 20 cm under the table. During evaluation scot-free, healthy, two cotyledon-containing seedlings were counted two times weekly, during 3-4 weeks.

Substrate preference examination

Substrate mixtures were:

1. Substrate (TS-3 Klassmann standard peat 100 %),
2. Substrate (TS-3 Klassmann standard peat and perlite 50:50%),
3. Substrate (Oasis seedling substrate), that is a peat-based mixture containing more components.

From all the six examined taxa, we sowed 50 seeds into 750 ml Swedish boxes. Based on the results of the previous sowing depth experiment, *Posdospermum* seeds got 1 mm cover with sifted Klassmann peat. Other taxa were sown on the surface of the substrates. We evaluated the experiment three times per week with counting the healthy, scot-free, two cotyledon-containing seedlings.

The following parameters were determined during the evaluation:

PI (promptness index): $PI=nd_2\times(1{,}00)+nd_4\times(0{,}75)+nd_6\times(0{,}50)+nd_8\times(0{,}25)$, where and means the number of germinated seedlings on the 2., 4., 6., and 8. day after sowing (HARTMANN ET AL., 1997).

MGT (mean germination time): $MGT= (\sum ni \times ti)/\sum n$, means the sum of multiplication of the given day (ti) and germinated seed (ni) / number of germinated seeds in the end of the experiment (n).

Germination rate, germination percentage at the end of the experiment.

G start: number of days from sowing till the appearance of the first seedlings.

G power: number of seedlings from the sowing till the 7. day (PEKARSKAS AND SINKEVIČIENĖ, 2011).

GSTI: Germination stress-tolerance index: (PI stress-conditioned seeds / PI control seeds)×100 (ASHRAF ET AL., 2006). We considered seeds as stress-conditioned that were covered with peat while control the uncovered seeds.

RESULTS

Comparison of populations based on germination parameters

The germination of the seeds derived from different populations can be read in *Table 1*. Except for *Aster tripolium* subsp. *pannonicum*, there was a big difference among the populations that determines the later seed collection. The single population of *Achillea aspleniifolia* germinated rather quickly, the achenes started to develop already on the second day after sowing (*Table 1*). We did not observe mentionable differences in the final number of seedlings among the populations of *Aster tripolium* subsp. *pannonicum*, however, the slowest seedling development was measured in the population of Fülöpszállás. Comparing the propagules of *Artemisia* from Apajpuszta and Farmos, we measured big differences in germination percentage and germination start. Propagules from Farmos germinated very badly but high mean germination time could be observed for the propagules from Apajpuszta as well. The parameters of *Inula britannica* were also diverse according to the different habitats. Best germinating rate could be measured in the Cegléd population. *Limonium gmellinii* subsp. *hungaricum* propagules derived from Apajpuszta had the best germinating parameters while seeds collected in Cegléd had the worst. Achenes of *Podospermum canum* from Dinnyés germinated the most quickly and those from Apajpuszta showed the worst results (*Table 1*).

Table 1. Germination rate of different populations

TAXON	HABITAT	PI	MGT	G rate	G %	G start	G power
Achillea	Dinnyés	35	1.12	0.45	45	2	28
Aster	Apajpuszta	5.4	12.83	0.33	33	7	7
	Cegléd	3.5	17.00	0.35	35	4	7
	Dinnyés	1.25	14.74	0.35	35	7	3
	Fülöpszállás	0.75	22.22	0.42	42	11	0
Artemisia	Apajpuszta	1.75	23.93	0.49	49	6	5
	Farmos	0	32.00	0.02	2	32	0
Inula	Apajpuszta	0	29.21	0.25	25	18	0
	Cegléd	2.25	22.58	0.56	56	7	7
	Dinnyés	3.25	10.00	0.18	18	7	7
	Farmos	0	26.00	0.04	2	24	0
Limonium	Apajpuszta	1.5	16.14	0.40	40	11	0
	Cegléd	0	27.33	0.05	5	21	0
	Fülöpszállás	1.75	16.25	0.29	29	7	5
Podospermum	Apajpuszta	0	27.60	0.18	18	14	0
	Dinnyés	18	7.39	0.69	69	7	38
	Farmos	3	15.24	0.55	55	7	8
	Fülöpszállás	3.25	19.55	0.73	73	7	11

Legend: PI – promptness index, MGT – mean germination time, G start – first day of germination, G power – number of seedlings in the first 7 days.

Examination of the effect of sowing depth on the germination of saline perennial species

In all examined parameters *Achillea aspleniifolia* proved to be the best among the six taxa, its stress tolerance was moderate. Both covering thickness values retarded all germination parameters (*Table 2*). *Aster tripolium* subsp. *pannonicum* had outstandingly high stress tolerance. Thin cover during germination favourably influenced promptness index (PI), mean germination time (MGT) and the number of seedlings till the 7th day (G power). The germination dynamics parameters of *Artemisia santonicum* were moderate but this species had the highest germinating percentage during the experiment. Stress tolerance index of the species proved to be low, it reacted badly for the treatments. This species was sensitive to covering. The time parameters (*Table 2*, 1. and 2. columns) of *Inula britannica* were good/moderate comparing to the other plant taxa, however its stress-tolerance index was the lowest and germination percentage was also very low. It reacted to the seed cover especially sensitive. Worst results were evaluated for *Limonium gmellinii* subsp. *hungaricum* in all examined parameters. Its stress-tolerance index was medium/low. The seeds germinated on light, did not tolerate any covering. *Podospermum canum* proved to be a highly stress-tolerant species. All germination parameters could be considered good although ten seeds were examined only in each treatment. Thin covering increased all the examined parameters, even 5 mm was more advantageous comparing to the uncovered control (*Table 2*).

Table 2. The effect of sowing depth on the germination dynamics of examined species

TAXON	TREATMENT	PI	MGT	GSTI	G rate	G %	G start	G power
Achillea	light	55.5	5	81.53	0.74	74	4	74
	1 mm	40.5	5.28		0.58	58	4	58
	5 mm	4.75	17.42		0.38	38	4	8
Aster	light	6.75	13	191.59	0.52	52	4	10
	1 mm	8.75	12.96		0.52	52	4	14
	5 mm	4.25	14.52		0.42	42	7	10
Artemisia	light	27.5	8.41	18.18	0.82	82	4	56
	1 mm	4	9.25		0.16	16	7	10
	5 mm	1	14		0.18	18	9	0
Inula	light	8.25	7.69	6.06	0.26	26	4	18
	1 mm	0.5	7.5		0.08	8	9	0
	5 mm	0	-		0	0	0	0
Limonium	light	1.25	14.88	20	0.16	16	7	2
	1 mm	0.25	17		0.12	12	9	0
	5 mm	0	-		0	0	0	0
Podospermum	light	1.75	10.5	528.57	0.4	40	7	20
	1 mm	6.75	7.63		0.8	80	4	70
	5 mm	2.5	9		0.6	60	7	30

Legend: PI – promptness index, MGT – mean germination time, GSTI – Germination stress-tolerance index, G start – first day of germination, G power – number of seedlings in the first 7 days.

Examination of substrate preference

Peat + perlite mixture had positive effect on germination rapidity of *Achillea aspleniifolia* while highest number of seedlings appeared in germination substrate. Germination dynamics was similar in the case of *Aster tripolium* subsp. *pannonicum* as well. Highest

germination percentage was observed in germinating substrate. *Artemisia santonicum* had the best germinating parameters, most of the seedlings appeared within 4 days after sowing (*Table 3*, last two columns). Dynamic germination was going on in *Inula britannica* nonetheless germination percentage was the lowest among the six examined saline perennial taxa. The PI values of *Limonium gmellinii* subsp. *hungaricum* were favourable. Though germinating time was between 8-13 days (depending on treatment), germinating rate was high, mainly in peat and peat + perlite mixture. Germination of *Podospermum canum* proved to be slow. Highest numbers of seedlings were counted in germination substrate until the last evaluation time (*Table 3*).

Table 3. Effect of different substrates on the germination dynamics of examined saline perennial taxa

TAXON	TREATMENT	PI	MGT	G rate	G %	G start	G power
Achillea	1. Substrate	2.25	15.67	0.24	24	7	4
	2. Substrate	6.75	6.78	0.18	18	4	12
	3. Substrate	1.5	13.9	0.4	40	7	2
Aster	1. Substrate	4.5	10.39	0.36	36	7	6
	2. Substrate	4.75	11.79	0.48	48	4	6
	3. Substrate	1	14.41	0.64	64	9	0
Artemisia	1. Substrate	38.75	5.48	0.58	58	4	52
	2. Substrate	29.25	4.88	0.48	48	4	44
	3. Substrate	6.5	10.57	0.6	60	4	10
Inula	1. Substrate	5.25	7.88	0.16	16	4	8
	2. Substrate	14.5	6.46	0.26	26	4	22
	3. Substrate	8.5	4	0.22	22	7	22
Limonium	1. Substrate	6.25	11.43	0.6	60	7	8
	2. Substrate	14.5	8.26	0.54	54	4	24
	3. Substrate	2.75	13.13	0.3	30	7	4
Podospermum	1. Substrate	0.5	16.67	0.36	36	9	0
	2. Substrate	0	19.45	0.4	40	12	0
	3. Substrate	0	19.04	0.5	50	14	0

Legend: PI – promptness index, MGT – mean germination time, G start – first day of germination, G power – number of seedlings in the first 7 days.

CONCLUSIONS

Summarizing the three experiments, we can conclude that there are very big differences among the Hungarian saline habitats. The best habitat was Fülöpszállás in case of *Aster tripolium* subsp. *pannonicum,* but the germination time was the highest. However *Artemisia* and *Limonium* seeds from Apajpuszta germinated the best. The highest germination rate was detected in the Cegléd population in case of *Inula*, and in the Fülöpszállás population in case of *Podospermum*. Most of the examined plants germinated on light without substrate cover, only achenes of *Podospermum* need shallow covering. The seeds germinated well in germinating substrate, but the highest germination rate of *Limonium* was measured in 100 % standard peat. According to the germinating dynamics and speed, *Achillea aspleniifolia* and *Artemisia santonicum* germinated very quick and well, while the other taxa germinated much slower and in low amount (e.g. *Limonium,*

Inula). Concerning germination percentage, best results were obtained with *Podospermum canum* in all the three experiments. However, in the case of *Inula britannica* and *Limonium gmellinii* subsp. *hungaricum* only every fourth – fifth seed developed to an intact seedling.

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RAPESEED CROP DAMAGE BY WILDLIFE ASSESSED FROM LANDSAT IMAGES

ISTVÁN SISÁK

University of Szeged, Agricultural Faculty
Institute of Plant Sciences and Environmental Protection
15. Andrássy St., H-6800 Hódmezővásárhely, Hungary
sisak.istvan@mgk.u-szeged.hu

ABSTRACT
Rapeseed is the fourth most important crop in Hungary regarding its cultivation area. Crop damage by deer and boar has been becoming strongly debated issue in the last few years. More exact clarification of damage was aimed at in this study with help of Landast images. Six rapeseed fields were investigated both in 2012 and 2013 in the administrative area of Várfölde, Bánokszentgyörgy, Bázakerettye and Borsfa (Zala County, Hungary). The total area in 2013 was 43 hectares. 100 % wildlife damage affected 3.9 hectares and 10 hectares were free from any damage. The total area in 2012 was 40 hectares in which 3.3 hectares were free from damage but neither fields suffered total damage. Yield map from 2017 of a 26 hectares field near to Gutorfölde and Szentkozmadombja was used to validate the space image based assessment method with real yield data. Landsat 7 images with acquisition dates of 2013.04.16., 2013.05.18. and 2013.06.03. were downloaded from the website of US Geological Service. All bands and NDVI index were investigated for all dates to establish best estimator for differences between damaged and not damaged fields. Band 5 (SWIR: 1.55-1.75 μm) in 16th of April proved to be the best. It was concluded with help of the reflectance data (zero damage: 96.4, complete damage:164.5, partial damage:124.7 on the average) that yield reduction was 41.5 % on areas with partial damage. There was no complete damage in 2012. However, reflectance data of not damaged fields were very close to each other in the two years (96.4 in 2013 and 89.9 in 2012 on the average) thus, it could be assumed that the same is true for reflectance data of completely damaged fields, so data from 2013 can be used for the comparison. Based on the data (zero damage: 89.9/2012, complete damage:164.5/2013, partial damage:118.4/2012 on the average) it was calculated, that one field suffered 38 % yield reduction, one hectare portion of another field suffered 23 % yield reduction, and other fields were not damaged significantly. Yield map from 2017 and Landsat 8 SWIR reflectance (Band 6: 1.566 – 1.651 μm) in 3rd of April have shown strong correlation (R^2=0,634), which was a direct evidence that both yield and wildlife damage of rapeseed can be reliably assessed from Landsat SWIR reflectance data acquired in April.

Keywords: rapeseed, damage by wildlife, Landsat 7, SWIR

INTRODUCTION

Rapeseed has been becoming more importance in the Hungarian agriculture for the last decades. Compared to the early 1990's when its production area was around 50 thousand hectares and the average yield varied between 1-2 tons per hectare, to-date it occupies more than 300 thousand hectares and the national average harvest has grown over 3 tons per hectare in the last few years with a record 3.6 tons per hectares in 2016 (KSH 2019a). The best farmers harvest well above 4 tons per hectare. Rapeseed advanced to the forth place among arable crops regarding the cultivation area (KSH 2019b) and being a high investment-high return commodity, it contributes significantly to the profitability of farms. Evidently any damage to this crop is a painful loss for the growers.
In the same period, large herbivore wildlife stocks soared too. Deer and boar combined bag increased from 81 thousand to 217 thousand between 1990 and 2018 (KSH 2019c). In the late 2000's and early 2010's the compensation for wildlife damage exceeded 2 billion Hungarian forint per year (CSÁNYI ET AL, 2011, 2012). Most of the damage was attributed to deer and boar (MÁTRAI AND JÁRÁSI 1986; BUZGÓ, 2006). Although systematic research on this relationship is scarce but there is a few spectacular anecdotal evidence for the

damage (e.g. VAOL, 2019; VADKARINFO, 2019) and scientific analysis (BLEIER, 2014) has also confirmed the exponential relationship between deer and boar abundance and compensation. Most damage in Hungary affects maize but rapeseed damages by deer and boar are becoming more and more important especially in Zala county where wildlife abundance is high (BLEIER, 2014).
Our study aimed at investigating Landsat images as tools to more precisely determine rapeseed crop damage by wildlife.

MATERIAL AND METHOD

Six rapeseed fields were investigated both in 2012 and 2013 in the administrative area of Várfölde, Bánokszentgyörgy, Bázakerettye and Borsfa (Zala County, Hungary). The total area in 2013 was 43 hectares. 100 % wildlife damage affected 3.9 hectares and 10 hectares (two fields) were free from any damage. That was confirmed by an official wildlife damage inspector in an official assessment. The total area in 2012 was 40 hectares in which 3.3 hectares were free from damage but neither fields suffered total damage. Again, this was confirmed in an official assessment. Yield map from 2017 of a 26 hectares field near to Gutorfölde and Szentkozmadombja was used to validate the space image based assessment method with real yield data. Data were recorded by a Green Star 3 Monitor. Study areas are shown on *Figure 1*. Landsat 7 images with acquisition dates of 2013.04.16., 2013.05.18. and 2013.06.03. were downloaded from the website of US Geological Service (USGS, 2019). All bands and NDVI indices were investigated for all dates to establish best estimator for differences between damaged and not damaged fields.

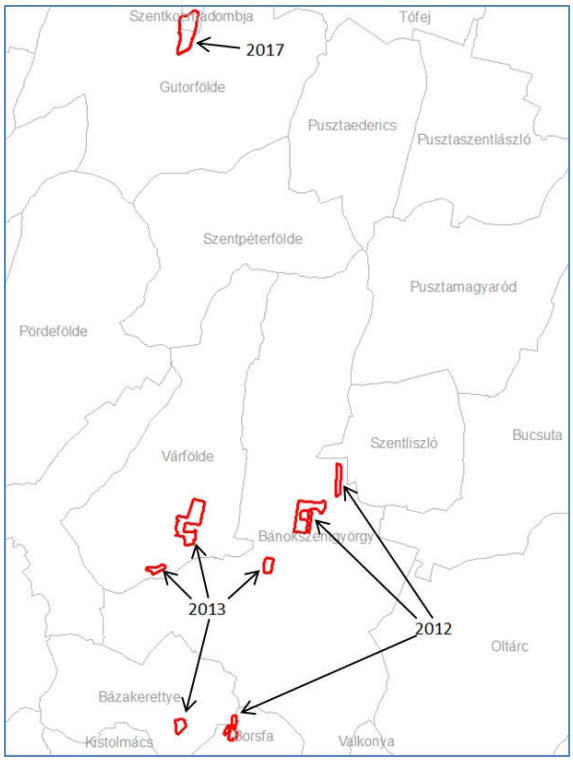

Figure 1. Study areas in Zala county

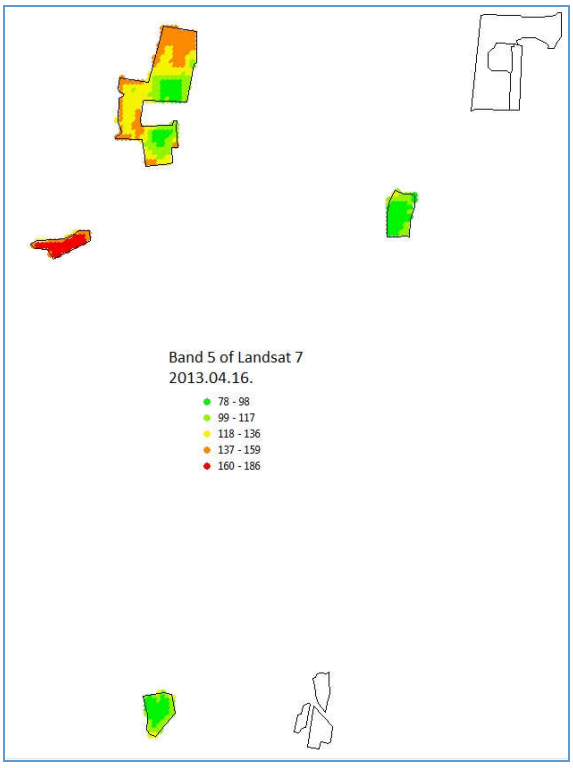

Figure 2. SWIR wavelength values in 2013

Landsat 7 images with acquisition date of 2012.04.29. and Landsat 8 images with acquisition date of 2017.04.03. were also downloaded from the same source and only the

best estimator wavelength bands (selected in the previous step) were used to assess crop damage or to validate reflectance values with yield map data.

RESULTS

Landsat 7 band data from 2013 were grouped in three categories: total crop damage, partial crop damage and no crop damage by wildlife. NDVI indices were calculated for all the three dates from Band 4 and Band 3 data. One way analysis of variance was applied to distinguish between the categories. The differences were significant for all NDVI indices and all wavelengths (bands). F test value of the ANOVA were used to select the best predictors for differences (*Table 1*). Band 5 of April 16th proved to be the best among all. Interestingly, NDVI indices performed rather poorly. This time the damaged crop was still in place. Band 5 and 7 of May 18th were better but by that time the damaged field was disk tilled already so the sharper difference was consequence of the tillage not of wildlife damage.

Table 1. F test values for the different variables

variable	F-value	remark	variable	F-value	remark
May18_B7	402,72	*	April16_ndvi	146,13	
May18_B5	325,37	*	May18_B4	115,99	*
April16_B5	250,64	best	June3_B3	95,34	*
April16_B7	237,16		June3_ndvi	94,39	*
June3_B5	224,64	*	May18_B8	72,90	*
May18_B3	216,29	*	June3_B4	70,13	*
June3_B7	204,02	*	June3_B1	65,34	*
May18_ndvi	189,92	*	June3_B62	63,34	*
April16_B3	185,89		June3_B61	61,82	*
May18_B2	182,69	*	April16_B4	51,48	
May19_B1	179,26	*	May18_B62	51,08	*
April16_B1	177,11		May18_B61	43,92	*
April16_B2	174,24		June3_B8	27,86	*
April16_B61	155,97		April16_B8	15,67	
April16_B62	154,68		June3_B2	4,23	*

*after disc cultivation on the field which were totally demaged by wildelife

Band 5 is the short wave infrared reflectance (SWIR: 1.55-1.75 μm). Its spatial distribution is shown on *Figure 2*. Considering the endpoints of the scale (no damage = 96.4 vs. total damage = 164.5) as detailed on *Figure 3*, the partial damage can be calculated: 41.5 %. Considering the area (28.6 ha) and the yield on not damaged area (4 t/ha) the total yield loss is 47 tons.

There was no complete damage in 2012. However, reflectance data of not damaged fields were very close to each other in the two years (96.4 in 2013 and 89.9 in 2012 on the average) thus, it could be assumed that the same is true for reflectance data of completely damaged fields, so data from 2013 can be used for the comparison. Based on the data (zero damage: 89.9/2012, complete damage:164.5/2013, partial damage:118.4/2012 on the average) it was calculated, that one field suffered 38 % yield reduction and a one hectare portion of another field suffered 23 % yield reduction. Three other fields were not

damaged significantly. Based on the areas and average yield (4.3 t/ha) the total yield loss was 15 tons.

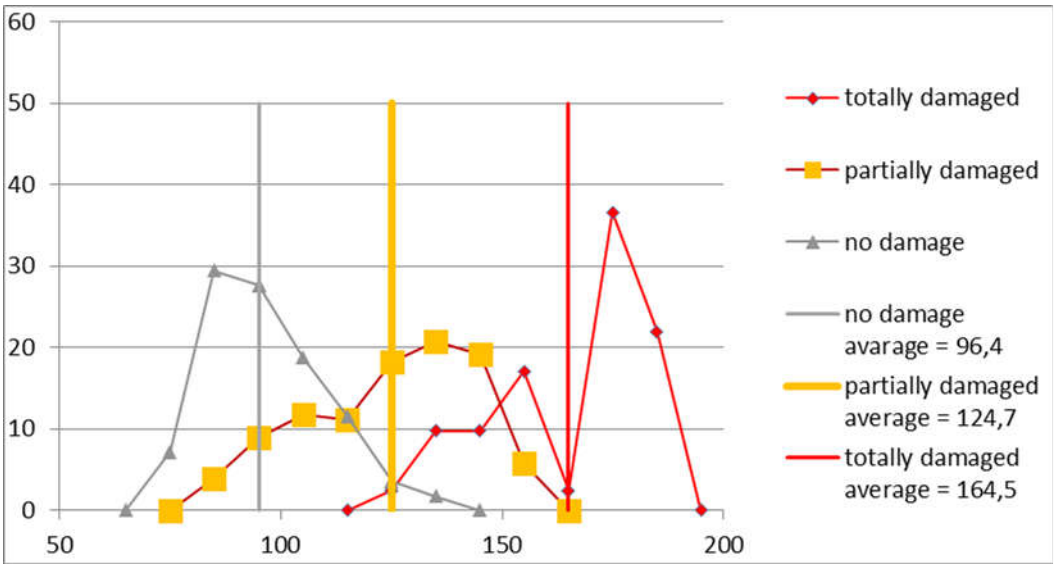

Figure 3. Distribution and averages of SWIR reflectance values for 2013

Landsat 8 SWIR reflectance (Band 6: 1.566 – 1.651 μm) in 3rd of April 2017 were validated with yield map from 2017. Landsat 8 images have pixel values between 0-65535 (2^{16}) while Landasat 7 images between 0-255 (2^{8}). Pixel values were recalculated to the range of Landsat 7 images, yield data were averaged for the 30x30 metre pixels of the images, and yield values with same reflectance value were averaged too. The relationship between pixel reflectance values and yield was acceptably strong (R^2=0.634 *Figure 4*).

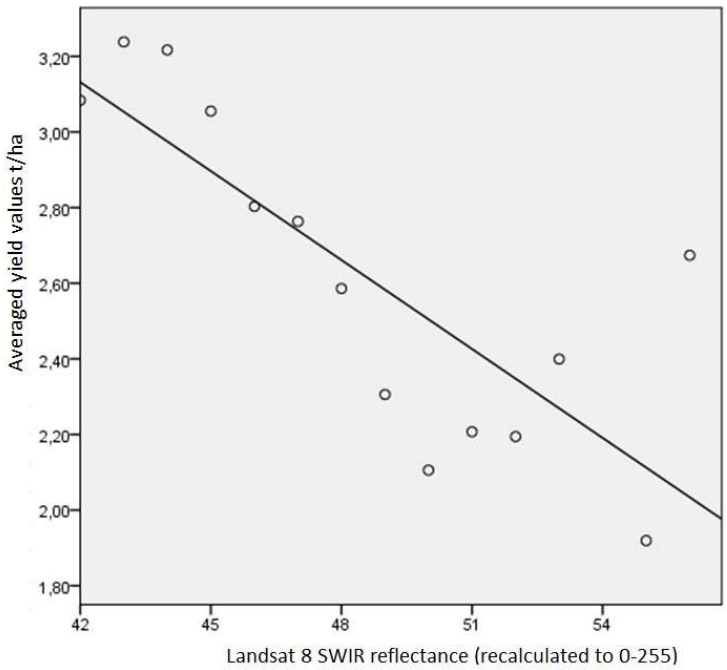

Figure 4. Regression between SWIR reflectance and averaged yield map data

CONCLUSIONS

Remarkable conclusion from our study that NDVI indices performed worse than SWIR reflectance. April is the flowering time of rapeseed when very intensive biochemical processes are going on parallel with a rapid growing. The SWIR reflectance value in April correlated very well with the yield harvested in early July as evidenced by the investigation for 2017. The distributions of the pixel values for 2013 (*Figure 3*) show some skewness for the not damaged area indicating weaker spots even in a field with high average yield. The pixel values for partly damaged field have overlapping bimodal distribution indicating relatively undamaged spots within the field. The pixel values for completely damaged filed show two distinct distribution. Higher values might indicate bare ground with total destruction of the crop and lower values might represent still existing, highly damaged crop. The divide between the two groups is exactly at the point where the distribution of partial damage cases which also confirms that conclusion.
Finally the conclusion can be drawn that SWIR reflectance values in April are good indicators for rapeseed yield and the proposed method is an appropriate tool for wildlife damage assessment in case reference values for zero and total damage are available.

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THE INTERACTIVE EFFECTS OF QUALITY AND QUANTITY PARAMETERS ON WINTER WHEAT VARIETY AND HYBRID ON CHERNOZEM SOIL

ÁGNES FEKETE, PÉTER PEPÓ

University of Debrecen, Institute of Crop Science, Faculty of Agricultural and Food Sciences and Environmental Management, 4032 Debrecen, Böszörményi Str., 138, Hungary
fekete.agnes.91@gmail.com

ABSTRACT
Wheat production is a determining branch within Hungarian crop production (near 1 million hectares). Weather anomalies caused by climatic change confirmed the importance of biological basis (variety, hybrid) in wheat production. The adapting ability and reaction of different wheat genotypes towards nutrient supply were studied in a long-term field experiment on chernozem soil type in case of different pre-crops (sweet corn, sunflower and maize). According to the experimental results of the vegetation 2017/2018 the most highest yield amount of the variety Ingenio sown after the pre-crop sunflower ranged between 2710 kg ha^{-1} and 8710 kg ha^{-1}, while the hybrid (Hyland) in case of the pre-crop sweet maize between 6556 kg ha^{-1} and 9270 kg ha^{-1} depending on the applied nutrient supply level. The studied genotypes showed the highest quality (protein, gluten) in case of the pre-crop sweet maize. In the cropyear of 2017/2018, the protein content of Ingenio ranged between 12.2-14.8%, while the Hyland in case of the pre-crops sweet corn between 9.9-13.9%. The gluten content of the Ingenio genotype changed between 24.9-32.5%, in the case of Hyland ranged between 16.9-27.3% in the studied cropyear.

Keywords: wheat, genotype, forecrops, yield, quality, fertilization

INTRODUCTION

Wheat production (nearly 1 million hectares) is the dominant sector of domestic crop production. The importance of winter wheat lies in its nutritional value (optimal balance of carbohydrates and protein content), its high ecological adaptability, and can be cultivated with full mechanization. The world's population is growing rapidly, requiring higher quality and higher yields (KRALJEVIC ET AL., 2007). The balanced nitrogen supply in the operation of sustainable agriculture is a worldwide problem. The nutrient supply of plants is based on two pillars: the nutrient supply capacity of the soil and the supply of artificial nutrients (JUHOS, 2015; LÁSZTITY ET AL., 1994). Increasing the genetic potential of winter wheat is basically dependent on the genotype and the agronomic interventions used (THRETHOWAN ET AL., 2012). Different ecological factors, agrotechnical elements (crop rotation, nutrient supply, irrigation, plant protection) fundamentally influence the quantity, stability and quality of the crop (PEPÓ, 2010). According to Pepó (2004), the rate of crop fluctuation in Hungary is higher than in other EU member states. Another determining factor in agricultural production is the high degree of climate variability. In recent decades, fluctuations in temperature and precipitation have become a decisive factor (HOFFMAN ET AL., 2007). This can be manifested in an increase in the average amount of precipitation or in the frequency of prolonged drought periods. In many cases, traditional varieties, under these extreme conditions, cannot realize their inherent genetic potential. In contrast to traditional varieties, the vitality, physiological activation and stress tolerance of hybrid wheat are much higher. As a result of the heterosis effect, the hybrid wheat has a higher yield potential. In addition, they have superior stress tolerance in droughty years, with poor soil conditions and prone to drought, and their crop stability is higher than traditional varieties. According to the results of Indian experiments, the cultivation of hybrid wheat

does not require more intensity than the technology of other cultivated winter wheat varieties (MATUSCHKE ET AL., 2007). In contrast, some research shows that winter wheat hybrids have higher yield potential, but the content of protein, alpha, and beta gamma gliadin is much lower (BUCZEK ET AL., 2016).
Our aim of these experiments and their results was to develop new technological solutions that can determine the pre-growth and nutrient response of the different genotypes of wheat, bearing in mind the elements of sustainable crop production. Our further objective is to develop crop production models and suggestions that will make it more efficient for farmers to grow their winter wheat with appropriate yield and protein and gluten content value.

MATERIALS AND METHODS

The University of Debrecen Institutes for Agricultural Research and Educational Farm Experimental Plant Látókép is located on the Hajdúság loess slate, about 15 km far from Debrecen. The soil of the experimental area is flat, balanced, geologically the chernozem type of lime-slag. The weather of the 2017/2018 breeding year was overall unfavourable. The mild autumn months followed by the gradual cooling of the rainy weather had a positive effect on the growth and initial development of the winter wheat and its tillering. February and March were colder than the average, so this had a negative impact on the development of wheat crops. During the vegetative development phase of winter wheat, April and May also had a negative effect on plant development and greatly reduced the phenological stages. The ripening of the stock occurred 1.5-2 weeks before the average. The experiment's forecrop was sunflower, corn and sweet corn. In the experiment, an early ripening group of mill-quality, whitish-wheat-type wheat, Ingenio, and winter wheat hybrids of outstanding vitality and high vintage stability in the late maturity group were examined by Hyland. On October 4, 2017, the optimal number of seeds of hybrids and hybrids was rejected with the Sulky seed drill in autumn. The long-term experiment was set up in the autumn of 1983. The field experiment was set in 4 replicates in a split-band arrangement. The plant protection applied in the experiment (weed control, twice fungicide, insecticide) met the requirements of modern cultivation. The winter wheat was harvested on July 1, 2018 with a Sampo plot harvester. The resulting crop results were processed using Microsoft Excel and SPSS for Windows programs. The results were evaluated by two-factor analysis of variance, based on the method of Sváb (1981) and Pearson's correlation analysis.

RESULTS

After sweet corn, corn and sunflower pre-harvest, the Hyland winter wheat hybrid reached higher yields at the control nutrient level (2458-6556 kg ha^{-1}). After harvesting corn, a relatively high yield was obtained in the control treatment (6556 kg ha^{-1}). The smallest crop of the two genotypes, at the control nutrient level in the 2018 breeding year, was the corn seedlings (*Table 1*).

1. Table: The effect of crop rotation and fertilization on the yield of winter wheat (Debrecen, Chernozem soil, 2018)

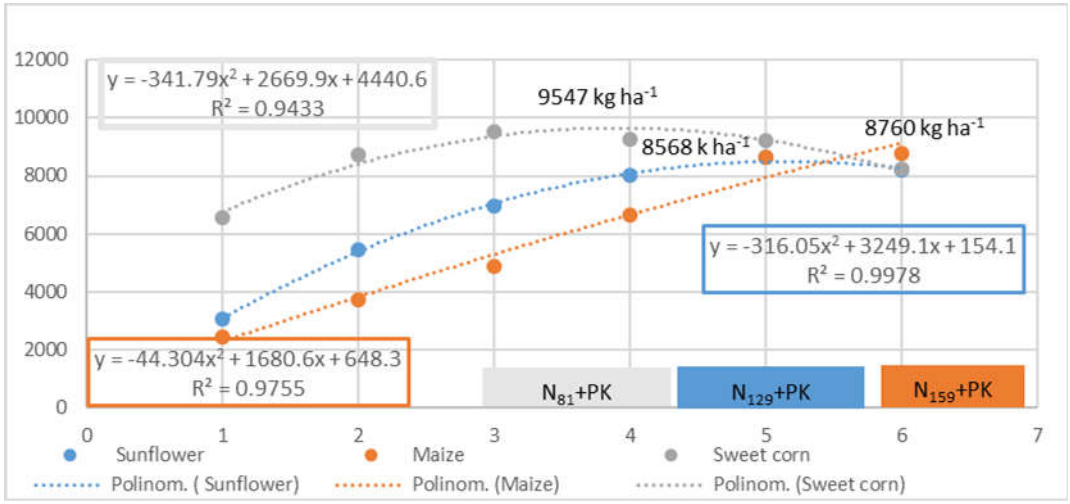
Genotype	Ingenio	Hyland	Ingenio	Hyland	Ingenio	Hyland
Forecrop	*Sweet corn*		*Maize Corn*		*Sunflower*	
Nutrient level	**Yield kg ha^{-1}**					
Controll	6010	6556	2027	2458	2714	3071
N_{90}+PK	7816	9270	7486	6650	8710	8017
N_{150}+PK	7488	8264	8361	8760	8708	8206
LSD5% Genotype	***499***					
LSD5% Forecrop	***1389***					
LSD5% Nutrient level	***774***					

In both genotypes, the nutrient levels increased, and the maximum yields are also increased. In the case of Ingenio winter wheat breed, we found that there was a significant difference between control and fertilizer treatments. The maximum yield was at the N_{90} + PK nutrient level (8710 kg ha^{-1}). The hybrid wheat has already reached its maximum yield (9270 kg ha^{-1}) after sweet corn pre-harvest at lower nutrient levels (N_{90} + PK). After the more unfavourable pre-cultures (corn, sunflower) the higher (+ PK) fertilizer dose proved to be optimal for the Hyland hybrid (8760 kg ha^{-1}and 8206 kg ha^{-1}). In the sweet corn pre-harvest, the Hyland hybrid wheat fertilization yielded 2714 kg ha^{-1}, the Ingenio wheat variety yielded 34% less (1806 kg ha^{-1}) yield (*Table 1*). The yield of hybrid wheat was 6302 kg ha^{-1} after maize and 5132 kg ha^{-1}after sunflower. After the forecrop Ingenio-type maize, a higher yield (6334 kg ha^{-1}) was achieved at the level of N_{150} + PK, while a higher yield surplus (5996 kg ha^{-1}) was observed after sunflower harvest at a lower fertilizer dose.

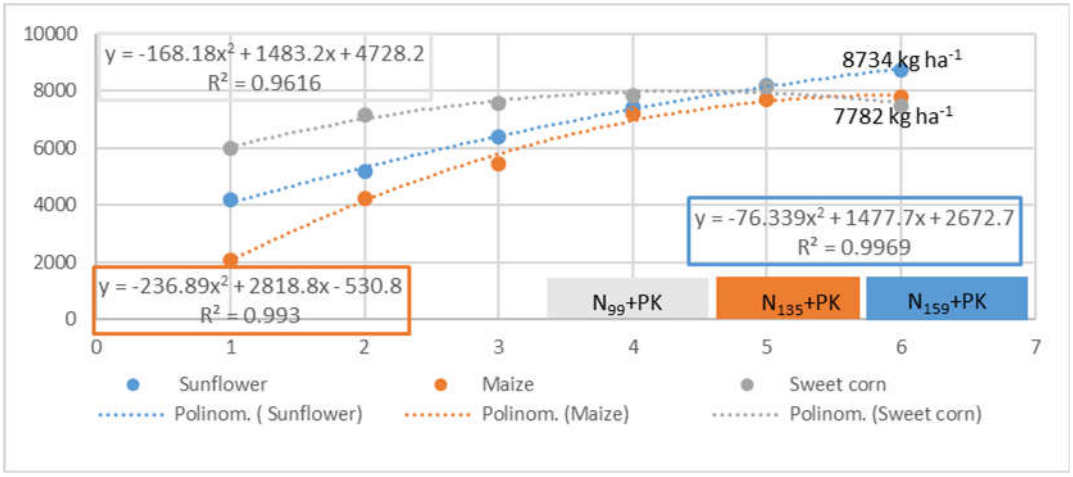
2. Table: Relationship between genotype, forecrop, fertilization, and quantitative and qualitative indicators by Pearson's correlation analysis

	Yield (kg/ha^{-1})	**Protein content (%)**	**Gluten content (%)**
Forecrop	-0.166	-0.344**	-0.386**
Genotype	0.044	-0.431**	-0.382**
Nutrient level	0.747**	0.665**	0.676**

Using Pearson's correlation analysis, it can be concluded that there was a close positive relationship between ration of nutrient management and yield (r = 0.747 **). In the 2018 breeding year, the forecrop (r = -0.116 **) and the genotype (0.044 **) had no effect on the yield of winter wheat *(Table 2).* Using the regression analysis of the variety and hybrid nutrient optimum *(Figure 1.),* it can be stated that under the given conditions, the optimal NPK dose of Hyland hybrid after sunflower pre-harvest at $N_{120\text{-}129}$ + PK nutrient level, while maize forecrop $N_{150\text{-}159}$ + PK nutrient level, after sweet corn $N_{81\text{-}90}$ + PK level.



1. Figure: Analysis of nutritional reaction of Hyland hybrid wheat (Debrecen, 2018)



2. Figure: Analysis of the nutrient reaction of wheat of the Ingenio breed (Debrecen, 2018)

Optimal fertilizer doses differ for the two genotypes. Based on these results, we found that for the Ingenio variety, the optimum fertilizer interval was $N_{120-135}$ + PK after sunflower, sweet corn forecrop $N_{120-135}$ + PK, and N_{90-99} + PK in the case of sweetcorn forecrop *(Figure 2)*. In the 2018 breeding year, after the sweet corn, the gluten content of the Ingenio breed developed favourably *(Table 3)*. After sweet corn, the gluten content ranged from 24.98% up to 32.50%. The Hyland winter wheat hybrid showed less wet gluten content (19.20% -27.35%) than the Ingenio variety in all three different nutrient treatments.

3. Table: Impact of precrop, genotype and fertilization on wet wheat content of winter wheat (Debrecen, 2018)

Genotype	**Ingenio**			**Hyland**		
Forecrop	*Sweet corn*	*Maize*	*Sunflower*	*Sweet corn*	*Maize*	*Sunflower*
Nutrient level	**Gluten content (%)**					
Control	24.98	18.08	17.95	19.20	16.98	18.43
N_{90}+PK	31.00	28.05	25.80	26.73	24.73	20.43
N_{150}+PK	32.50	28.73	28.65	27.35	25.45	22.30
LSD% Genotype	**0.92**					
LSD% Forecrop	**1.31**					
LSD% Nutrient level	**2.69**					

After sweet corn, we found a statistically verifiable difference between the hybrid gluten content of winter wheat at each of the three nutrient levels. Compared to the results of the control plots, each additional nitrogen dose increased to a different extent, but increased in the gluten content of both genotypes. In the case of Ingenio breed, the growth was nearly 10%, while in the case of Hyland hybrid wheat, the growth was almost 9%. Both genotypes achieved the highest gluten content at the N_{150} + PK nutrient dose (32.50%, 27.35%). On the basis of the results, the winter wheat showed weaker values by 4-6% compared to the breed. In the case of maize forecrop *(Table 3),* the results of control treatment showed that this forecrop had an adverse effect on the gluten content of both genotypes. In control treatment, the content of gluten varied between 17.95% and 24.98% for Ingenio winter wheat. The highest value was measured after sweet corn, the smallest after sunflower. However, we only found a significant difference in the values of sweet corn and maize and sweet corn and sunflower. Examining the results of the Hyland wheat hybrid, it was found that there was a statistically verifiable difference between the three precrops. The wet gluten content ranged from 16.98% to 19.20%. In the case of hybrid wheat, the smallest gluten content was found in maize (16.98%) and highest in sweet corn (19.20%) in the 2018 breeding year *(Table 3).* The correlation between nutrient management, precrop, genotype and the examined quality indicators was investigated by Pearson's correlation analysis (*Table 2*). Nutrient supply significantly influenced the gluten content of winter wheat that were established a close significant relationship (r = 0.665 **). The gluten content values were also modified by the forecrop and genotype, i.e. there was a moderate negative relationship (r = 0.386 ** and r = 0.382 **). Based on data from the 2018 breeding year, we found that for all three precrops the maximum protein content was the lowest on the control plot *(Table 4).* By increasing the nutrient doses, to a different extent than the two genotypes, the protein content increased. The highest protein content at the N_{150} + PK level was produced by the Ingenio breed (14.80%), after sweet corn seedling. Comparing the results of the two genotypes, the highest level of crude protein was found after the sweet corn at the control nutrient level, in the Ingenio winter wheat breed (12.25%). After harvesting maize and sunflower, this value has been moderately reduced. The Hyland hybrid, like the variety, achieved a higher protein content of sweet corn (10.20%). After sunflower pre-harvest, the protein content (10.10%) was more favourable than after maize (9.93%).

4. Table: Impact of forecrop, genotype and fertilization on protein content of winter wheat (Debrecen, 2018)

Genotype	**Ingenio**			**Hyland**		
Forecrop	*Sweetcorn*	*Maize*	*Sunflower*	*Sweetcorn*	*Maize*	*Sunflower*
	Protein content (%)					
Nutrient level						
Control	12.25	9.98	9.93	10.20	9.40	10.10
N_{90}+PK	14.33	13.68	12.78	12.80	12.23	10.68
N_{150}+PK	14.80	13.95	13.80	12.95	12.33	11.18
SZD5% Genotype	**0.28**					
SZD5% Forecrop	**0.97**					
SZD5% Nutrient level	**0.46**					

By increasing the nutrient doses, the protein content was different to the two genotypes but increased. The highest protein content at the N_{150} + PK level was produced by the Ingenio breed (14.80%), after sweet corn. At Hyland winter wheat hybrid we measured a lower

protein content compared to the breed. Its best protein content was 12.15% after sweet corn. Using Pearson's correlation analysis, it can be concluded that there was a strong (r = 0.665 **) positive relationship between nutrient management and protein content, thus, significant increase in protein content was achieved by increasing nutrient doses. In the 2018 breeding season, there was a moderate negative relationship between the winter wheat genotypes and the pre-crop (r = -0,344 **) and the genotype (-0,431 **).

CONCLUSION

The weather anomalies caused by climate change in wheat production have increased the role of biological foundations (breed, hybrid). According to the results of our 2017/2018 experiments, the yield of the Ingenio breed after sweet corn forecrop is 6010-7816 kg ha^{-1}, after maize forecrop 2027-8361 kg $ha^{-1}$and after sunflower 2714-8710 kg ha^{-1}depending on fertilizer treatment. In the case of Hyland's winter wheat, the yield of the hybrid is 6556-9270 kg ha^{-1}, after maize forecrop 2458-8760 kg $ha^{-1}$and after sunflower 3071-8206 kg ha^{-1} depending on fertilizer treatment. In the given year the two genotypes showed different quality (gluten, protein) parameters. In the case of Ingenio breed, the content of protein after sweet corn forecrop varied from 12.25% to 14.80%, after maize was 9.98-13.95%, after sunflower was 9.93-13.80% depending on fertilizer treatment. Winter wheat hybrid had moderately less protein content in the year under review. For various fertilizer treatments, the protein content of wheat was 10.20-12.95% after maize forecrop, 9.40-12.33% after sunflower, 10.10-11.18%. Winter wheat gluten content for Ingenio breed, depending on the amount of fertilizer dose, was 24.98-32.50% for sweet corn forecrop, 18.08-28.73% for corn, and 17.95-28.65% for sunflower. In contrast, hybrid wheat produced lower quality in the breeding year 2017/208. The content of gluten varied between 16.98 and 27.35%, depending on the forecrop and nutrient levels.

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INVESTIGATION OF FARMERS' MARKETS FROM THE SALES SIDE

NÓRA GOMBKÖTŐ

Széchenyi István UniversityFaculty of Agricultural and Food Sciences
9200 Mosonmagyaróvár Vár tér 2., Hungary
gombkoto.nora@sze.hu

ABSTRACT
Farmers' market may solve many problems concerning long-distance transport. In this sales form, physical distance is reduced between the producer and the consumer, furthermore personal relationships and trust can be also established between these two actors. In addition, it provides small producers with the opportunity for producing and selling local, high-quality foods, and consumers are able to enjoy delicious, mostly local organic food products. Farmers' market is an increasingly popular sales channel in Hungary. While in 2010 there were 100, in 2014 there were around 200 farmers' markets, in 2017 their number increased to more than 250. The National Rural Development Program also encourages the sale of local products in this form. In this paper, a questionnaire survey was conducted with producers in the largest farmers' markets of the Transdanubian Region in Hungary, which was used to analyse the farmers' market features of the region.

Keywords: farmers' market, sales, questionnaire survey, differences, market opportunities

INTRODUCTION

Recently, conventional farming is increasingly replaced by alternative farming methods (ecological, integrated, etc.), which have a positive impact on the environment and health as well. Number of conscious customers are increasing gradually, who consider the origin and quality of the eaten food, and they are looking for such purchasing opportunities where they can get information about the product, make sure about taste and quality of the product based on several product samples. Therefore, there is a need for methods that meet this need in a local, safe and sustainable way. The so-called short supply chains (RELs) may be appropriate option due to reducing physical distance between the producer and the customer and in most cases production take place within the framework of organic farming. Farmers' market is one of the possible types of short supply chains. It follows the principle of direct sales by excluding retailers, therefore they are classified as short food supply chains (PÓLA, 2016).

Local farmers' market is a market where small-scale farmers sell agricultural or food products from their farm. These farms are generally located within a distance of 40 km of the market or respective the capital anywhere in the country. Local and fresh products can be easily accessed by these attractive markets, which recently occur at more and more places. Farmers' markets give consumers the opportunity to buy domestic foods produced by small-scale farmers. This strengthens not only the customers' health awareness, but also the fact that by purchasing the farmers' products they support their livelihoods and it promotes the spread of consumption of domestic, small-farmers' foods. By creating a relationship of trust between the producer and the consumer, farmers have the opportunity to focus on quality of their products with even better products, while the consumer can get food that has a well-known origin and the way of production. The basic differences between farmers' markets and traditional markets are represented in *Table 1*.

Table 1. Comparison of local farmers' market and traditional market

	Local farmers' market	**Traditional market**
Operation	only notification (at the competent municipal notary)	require authorization (at the competent municipal notary)
Vendors	small farmers	small farmers, farmers, food and non-food companies, retailers
Territorial restriction on sales	Products may be sold in the following territories: – in the county of the small farmer, or – in the airline, within 40 km of the farm, or – from anywhere in the country on the local market in Budapest.	Non-animal basic products, honey, live fish may be sold to the final consumer nationwide, at all markets and fairs. Basic products of animal origin and any processed products may be sold on the Hungarian markets within the region (in his own county and in Budapest), as well as in the air, 40 km away from the farm. Undertakings that are authorized or not notified under the Small Producer Regulation may sell their products on the market without territorial limitation.
Product range for sale	Agricultural products from small farm and food produced by the small farmers.	Any product with appropriate permissions/conditions.

Source: Nemzeti Agrárgazdasági Kamara, 2016

Farmer's market provides sales opportunities for local producer farmers occasionally, periodically or regularly, which may be organized by a local group of farmers, the local government, an integrator or other organization (KAJNER, 2007). This type of sales constitutes a new legal option, which can be organized periodically under lightened conditions, and there is no need for an intermediary **(**HINRICHS, 2000). These markets can be specialized in organic products, but organic farmers also can join the already existing markets integrating traditional products.

One of the most important rules of local farmers' markets that only local small-scale farmers or licensed traditional small-scale producers may sell on the market.

A small-scale farmer is a person who sells small quantities of food produced by himself/herself or processed from the raw product. It is important that the small-scale farmer may supply the retailers and catering organizations located up to 40 km from the farm. Small-scale farmers' raw products include vegetables, fruits, milk, live animals, eggs, honey and mushrooms, while processed products include fruit juices, cheese, butter, cottage cheese, sausages and jam. Licensed traditional small-scale producers are not private entrepreneurs and they produce on his own farm and can prove it by his/her licence. Small-scale farmers and licensed tradition small-scale producers have to comply with a number of rules of sale in farmers' markets. For instance they have to ensure fruits and vegetables which are healthy, clean, pest-free, strange taste-free and odor-free quality. In addition, products must be in a condition that they can be transported and arrive at the set market in an appropriate condition. It must be emphasised that the producer is responsible for the quality, food safety, documentation and traceability of the product (KOMÁROM-ESZTERGOM MEGYEI KORMÁNYHIVATAL, 2017).

Farmers' markets have many strengths, weaknesses, opportunities and threats. Strengths are the follows: sale of fresh goods, immediate revenue, building trust, more choice and relatively constant prices. However, the weakness includes the long distance between settlements, where purchasing power is centralised, the higher cost of delivering to the market, the non-transparent food security is, lack of commercial knowledge, lack of cooperation among producers, and uneconomical logistics processes. Opportunities of local market are that it may lead to a change in consumer behaviour, an increase in demand, or a move towards quality products by catering units. Threats may include lagging areas, legal background, lack of support, and customer distrust.
According to the register of the National Chamber of Agricultural Economics, there are currently 251 farmers' markets in Hungary.

MATERIAL AND METHODS

Farmers' markets were examined from supply side. Data were collected from six major farmers' markets in the Transdanubian region of Hungary in 2017. Research focused on the characteristics of farmers selling. The main products of the viable farmers and concerning main features (e.g. product groups, arable land, number of employees) were explored and determined. The survey was carried out by questionnaire concatenated with interviews. A total of 68 questionnaires were completed in this way.
The evaluation of the given responses was performed using basic statistical methods (mean, standard deviation, ratio, analysis of variance, correlation). Using analysis of variance (ANOVA), it was examined whether there is a significant difference between the observed six farmers' markets in any aspect, that is, whether different location affects the specificities of the farmers on the set markets. After that, farming and marketing characteristics of farmers were examined on detail based on responses given by producers in each market.

RESULTS

As for the analysis of variance (ANOVA), the number of scores in each treatment (r) is the number of farmers surveyed per market, while the number of treatment conditions (k) is equal to the number of observed farmers' markets. Thus, the total number of scores is the multiplication of the two ones ($n = r \times k$). With these data, the analysis was carried out for a total of 14 factors that show some of the farming and sales characteristics of the farmers'.
In calculations, F-ratios were calculated in case of all 14 factors. Since the two degrees of freedom were always the same, each test was associated with the same critical value (F-critical).
The result of the variance analysis shows that in view of four factors (the farmers, the number of employees, the type of sold products and the marketing tools used), differences can be observed depending on farmers' location. Accordingly, there are differences in two main region, on the one hand in territories located closer to the capital and to the central part of the country, on the other hand in the counties located along the western part of the country. In case of the first-mentioned farmers that they have higher educated (60%), have higher number of employees (2-3 per farm), produce more processed products, and use more marketing tools (4-5) to promote their products, than farmers from the other region. In the opposite, farmers in counties of the western part of the country have lower qualifications (20-40%) and fewer or zero employees (0-1 people), the number of their unprocessed products are much higher and they use fewer (2-3) marketing tool.

66% of the respondents are working with products of plant origin, 30% of them are working with products of animal origin, while 2% of them are working with mixed products, however, there is a significant difference between the two regions mentioned above, as most of the products of animal origin are produced in the central areas of the country. Within products of animal origin (e.g. milk, dairy products, live pigs, pork, dry goods, eggs, honey), products of different animal species appear in almost the same proportion, nearly 60% of which have been processed.

90% of products of plant origin come from the horticultural sector (vegetables and fruit in the same proportion). They can be also characterized by the fact that half of the farmers produce vegetables and fruits. When it comes to fruits, 1/3 of the farmers sells only fresh fruits, 1/3 of them sells only some kind of fruit products (jam, syrup and juices) and 1/3 of them sell a mixed palette (fresh and preparations). For vegetables, fresh and unprocessed goods are the most popular (70%), a small proportion (20%) of producers sell only vegetable products while mixed sales features only the 10% of farmers. For this latest mixed sales, 50% of the products are fresh and 50% of them are processed.

In addition to the farmers' market, farmers sell their products on average 2-3 distribution channels, but the number and type of these channels differ from each other. While in the central region of the country usually 1-3 distribution channels are used, in the western region of the, it is preferred to 2-6. This is because of that the middle areas are closer to the capital, where there are several markets available, while far away farmers have to use multiple distribution channels to sell their product. It is equally true for each region that the most favoured distribution channels, in addition to farmers' market, are traditional market (preferred by 59% of farmers), as well as sales from the home (preferred by 60% of farmers). The latter is chosen rather by producers of animal products (including beekeepers as well), but less by fruit growers, while vegetable growers choose this type of sales not in the least. Nearly a quarter of the farmers sell to buyers, restaurants and by home delivery as well. The latter two ones appear in a larger proportion in western regions (48% and 38%). In this area, however, it is not important to sell to bio stores, greengrocers, consumer communities or online, while in the middle region these channels are also present in one-quarter of the farmers. It can be said that all the surveyed farmers in all the regions sell hardly at the fairs, along the way, or by PSOs (Producer Sales Organizations).

As for buyers, each farmer has regular buyers and occasionally about 15 to 40 buyers visit them on the farmers' markets.

Almost one third of the farmers have to looking for additional markets beyond 40 kilometres away from local sales and only about 15 percent of them have the opportunity to sell locally (within 5 kilometres). Most of them operate in regions close to the capital. There is also a relatively large standard deviation between the delivery distances of farmers producing different product types, particularly between vegetable growers and mixed production (vegetable and fruit growers) farms. However, it is basically a fact that producers of animal products sell within relatively small distances (within a radius of 25 km), obviously because of the viability and perishability of the products. Beekeepers and fruit growers deliver their products rather to long distances (50-100 km).

As for marketing tools, the world of mouth (WOM) is the most commonly used and popular advertising that applied by at least three quarters of all producers, the producers trust this most. A customer's positive feedback about a product, giving the feedback to friends, is the best advertising for the farms. Based on the results of the variance analysis, it can be stated that the marketing tools used by the producers vary considerably between regions.

Even though more than half (53%) of all producers use online advertising, this marketing tool is mainly popular in the middle region of the country, where 70% of producers use it

on a daily basis for marketing. Advertising board is also popular in this region, while in the western part of the country is preferred the leaflet. Concerning other marketing tools, standard deviation is extremely high for both producers and county markets as well. The print media, the use of vehicle advertising, product promotion at exhibitions, fairs and the delivery of the product sample to the consumer are also displayed. Printed media, vehicle advertising, promotion at exhibitions, fairs and product samples also occur.

CONCLUSIONS

During this research, farmers' markets from different regions of Hungary were examined in order to find out what characteristics have domestic farmers who choose this relatively new distribution channel and whether there are territorial differences within the country.
Each of the interviewed farmers drew attention to the importance of farmers' markets. Their confidence in the new system is reflected both in their credibility and commitment, which they can best demonstrate with their long-term plans. However, the most prominent similarity is the focus of humanity on all three markets, namely that they focus meet individual needs, They can also provide customers with quality food that does not disappoint their customers. This was pointed out by the survey with the daily number of customers and the frequency of regular buyers.
As for regional differences, two major regions can be distinguished where specific characteristics of producers (qualification, number of employees, type of products, marketing tools) differ from each other significantly. One such area is the western region of the country and the other one is the central part of the country. The latter is closer to the capital, obviously, the characteristics of this region is fundamentally influenced by this proximity. Respectively the product ranges, it can be stated that a smaller proportion of farmers deal with animal products, only in the middle regions, so it would be desirable to promote the production of these products nationwide.
Due to the higher costs, and thus the risk of a lower profitability, only a small proportion of farmers are organic producers. However, consumers appearing on special markets require a higher quality, healthy product, thus the sales volume of organic products may be increased in these markets, which would ultimately increase profitability.
Farmers in the western region try to sell their products through a number of sales channels, while in the middle region, far less marketing channels are applied due to the market potential of the capital, so their delivery distance is much lower. Besides the farmers' market, the most popular sales channels are the traditional market and the home sales. Other sales channels are not known or used minimally. However, these could provide new opportunities for farmers. The intermediary role of PSOs is not used, which could, however, significantly facilitate the sale of their sales. In the long term, it would be useful to promote other sales channels among producers by different professional organizations.
It would be very important issue to introduce and promote farmers' markets among all age groups. There should be an opportunity to get more information on this topic. With the involvement of the media, the already existing producer markets could be promoted focusing on healthy, quality foods. With widespread of awareness of health, it is possible to reach different ages with log of internet journalists', lifestyle magazines, and TV interviews. In our opinion, the attention of the younger generation could be brought by posts of well-known people in social media. Additionally, the popularity of visiting farmers' markets could be promoted by combination with special events, festivals which would attract mass of consumers to the market and are visited not only by the neighbourhoods but the residents of distant settlements. In addition to these events, several family days could also be a good option to introduce these farmers' markets. We think it

would be expedient to increase the opening hours of farmers' markets. It would be important not only to open up a single day, but at least on an ordinary and a weekend day as well.

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EFFECT OF CRYOGENIC FREEZING ON THE TEXTURAL AND SENSORIC PROPERTIES OF DONUTS

KARINA ILONA HIDAS[1], ADRIENN TÓTH[1], ESZTER HAMAR[1], IVETT JAKAB[2], LÁSZLÓ FRIEDRICH[1], CSABA NÉMETH[3]

[1]Szent István University
Department of Refrigeration and Livestock Products Technology
Budapest 1118 Ménesi St. 43-45.
[2]Szent István University
Department of Grain and Industrial Plant Processing
Budapest 1116 Villányi St. 29-43.
[3]Capriovus Ltd.
Szigetcsép 2317 Dunasor 073/72.
Hidas.Karina.Ilona@phd.uni-szie.hu

ABSTRACT
Cryogenic freezing is a mild freezing technology due to the formation of small ice crystals. This preservation technology is well applicable for increasing the shelf life of bakery products. In our experiment, we made donut samples of matured dough, traditional dough with pork fat, and dough with increased fibre content made by adding flaxseed flour. They were fried in palm oil and also in high oleic sunflower oil. Donuts were frozen in liquid nitrogen for 60 seconds and they underwent a storage of 7 days at -18°C. Thawing at room temperature and thawing in oven were tested. We investigated how freezing, frozen storage and different thawing processes affect sample texture by penetration. The effect of freezing on water activity and sensory properties were also investigated. In our experiment we found that cryogenic freezing influenced the texture of prepared donuts, but sensory evaluation have shown that this does not lead to a decrease in popularity. In addition, a slight decrease in water activity was observed after freezing and thawing. Heating in oven proved to be the better method for the thawing process of donuts based on sensory properties of products. In addition, consumers preferred the increased fibre content of doughs.

Keywords: cryogenic freezing, donut, texture analysis, sensory analysis

INTRODUCTION

Baking is an ancient, traditional process. Bakery products are the simplest plain pastries, which contain just few ingredients, but they are cakes of numerous components, as well. The term baking is applied for the production of bread, but also for all food products in which the basic material is flour. These products are radiated by heat from the walls and/or top and bottom of a heating equipment (HUI ET AL., 2006). However, donuts are actually fried products, but they inner core is more alike baked products. They absorb substantial amounts of oil during frying (SHIH ET AL., 2001).
Flaxseed nutrition research has increased the potential to be considered as a new ingredient in bakery products (CHETANA ET AL., 2010). Interest in flaxseed consumption is associated with high levels of α-linolenic acid, dietary fibre mucilage, lignans and phenolic compounds, all of which are likely to be useful in reducing coronary artery disease, and risk factors for cancer (HOLMAN ET AL., 1982; CUNNANE ET AL., 1993). CHETANA ET AL. (2010) made muffins containing different amounts of flaxseed flour. They concluded that flaxseed increased the water absorption of the flour, like other fibre sources. SHIH and DAIGLE (1999) reported that long-grain rice flour absorpted less oil than wheat flour during frying.

Nowadays, food preservation technologies are very important to increase shelf life and maintain the nutritional value, texture and flavour of food products (KAALE ET AL., 2011). At temperatures of frozen storage (-18°C to -40°C) microbiological activity is reduced (GALLART-JORNET ET AL., 2007).

The term cryogenic is applied generally below the temperature of -150°C. In contrast, liquid nitrogen (-196°C) or carbon dioxide (-78°C as a solid) are applied directly to food products as freezing medium. Shorter freezing times can be achieved with this process. There is a big temperature difference between the cryogen and the product surface. The high rate of surface heat transfer resulting from the boiling of the cryogen (ZHOU ET AL., 2010).

The goal of our experiment is to investigate the impact of cryogenic freezing on texture, water activity, and sensory properties of donuts made of different doughs, and fried in different media.

MATERIAL AND METHOD

Donut samples

In our experiments we made donuts based on different recipes and frying methods. A total of 6 products have been tested. These are shown in *Table 1.*

Table 1. Tested donut samples

Dough	Frying medium	Sample code
Matured dough	palm oil	K12
	high oleic sunflower oil (HOSO)	K12-HN
Traditional dough with pork fat	palm oil	W7
	high oleic sunflower oil (HOSO)	W7-HN
Dough with increased fibre content (by 10% flaxseed)	palm oil	K-A
	high oleic sunflower oil (HOSO)	K-A-HN

Freezing and frozen storage of samples

After cooling, donuts were frozen by immersion in liquid nitrogen. 15-15 donuts from each types mentioned before were immersed in liquid nitrogen (Messer Hungarogáz Ltd., Hungary). Liquid nitrogen began to boil with a temperature of -195,8°C due to the high temperature difference between the liquid nitrogen and the products. Samples were removed after 60 seconds from the liquid nitrogen by using a stainless strainer. They were then packed into polyethylene bags, sealed with a foil welder and stored in a freezer (Zanussi ZFC26400WA, Italy) at -18°C. Samples were tested 24 hours (day 1) and one week (day 7) after freezing.

Thawing process

Two different thawing methods were tested in this experiment. The first method was letting unpacked donuts thaw at room temperature (20°C). Our second method was to heat donuts in a preheated oven by convection at 200 °C for 7 minutes.

Measuring of water activity

The right amount of free water in the food is essential for the microorganisms, so it is essential to study the water activity in the preservation processes. Water activity was measured by Labmaster-aw (Novasina, Switzerland) before freezing and one day after

freezing. Measurements were made at 25 °C with three replicates, maintaining the ratio of dough to filling.

Texture analysis

Texture properties of different donuts were determined by TA-XT Plus (Stable Micro Systems, UK) by penetration. A penetration cylindrical probe (P/5) with a length of 5 cm, a diameter of 5 mm was used. Measuring cylinder was adjusted to the surface of the samples. The measuring program included a motion of 40 mm downwards by a speed of 2 mm/s. Measurements were performed on fresh donuts, on day 1 with both of the thawing types and on day 7 in the oven heated samples. In each case, 5 to 5 measurements were taken on each sample and two samples were analysed, so 10 replicates were performed.

Sensory evaluation

Consumer sensory tests were performed with 12 consumers, where samples were given three-digit numbers. The following aspects had to be evaluated on a scale of 1 to 10 (1 disliked, 10 favoured): dough colour, odour, taste, texture, greasiness, properness of baking, freshness and overall impression.

Statistical analysis

Data were analysed by IBM Statistics 24 software. Univariate ANOVA was used to decide whether data are different or not. We checked homogeneity of variances by Levene's test (F_{max} ($F(23;216) = 1.046$; $p=0.410$), W_{pen} ($F(23;216) = 1.213$; $p=0.236$), A_w ($F(11;24) = 2.499$; $p=0.29$) and normality of data by Kormogorov-Smirnov and Shapiro-Wilk tests (F_{max} ($k(240)=0.049$; $p=0.2$), W_{pen} ($k(240)=0.055$; $p=0.078$), A_w ($k(36)=0.948$; $p=0.088$)). We used Tukey tests if variances were equal and Games-Howell test if they were not equal to get differing groups.

RESULTS

In our experiment we found, that the samples thawed at room temperature had unfavourable sensory properties. In addition, their handling is difficult, and due to the long and unregulated thawing process, it is also disadvantageous from an industrial point of view. Therefore, only samples thawed in the oven were examined in the measurement of the water activity. Texture analysis was performed on the samples thawed at room temperature only on day 1.

Changing of water activity

Figure 1 shows the water activity of examined donut samples before and after cryogenic freezing. We performed univariate ANOVA based on 3 factors. These factors are the following: frying medium, dough material and freezing. The effect of frying medium was not significant (Aw, oil ($F(11;24)=0.284$; $p=0.599$)), but the effect of freezing and dough material was significant ($A_{w,\ dough}$ ($F(11;24)=10.236$; $p<0.001$), $A_{w,\ time}$ ($F(11;24)=11.899$; $p<0.01$). Freezing and thawing decreased water activity. This may indicate that during the thawing (baking in oven for 7 minutes at 200°C) a certain amount of water has been lost (evaporated). In addition, dough material had a significant effect on water activity, as well. Water activity of matured dough was significantly higher, than the other samples doughs water activity.

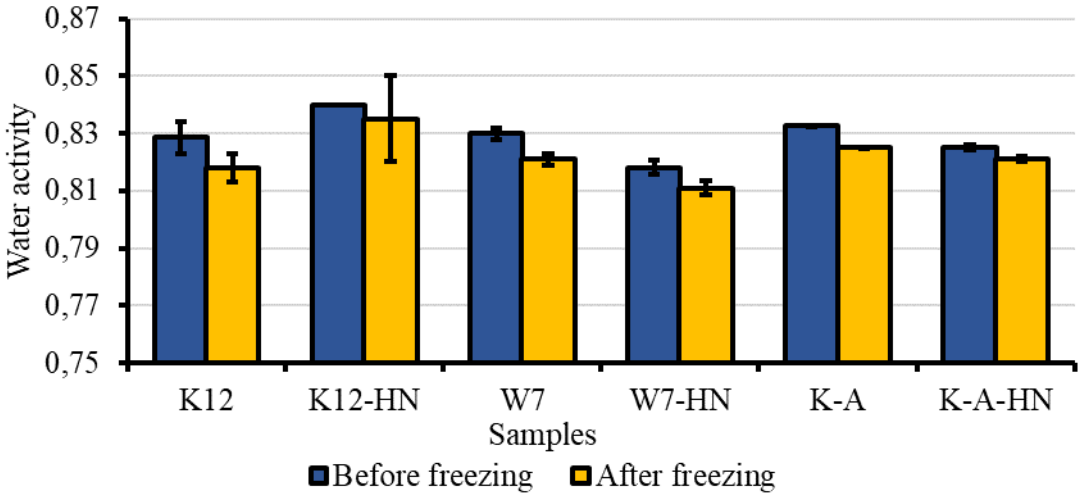

Figure 1. Water activity of donut samples before and after cryogenic freezing

Results of texture analysis

The results of the maximum penetration force describe the force required to penetrate the probe to draw conclusions on the hardness of the product. *Figure 2* shows the maximum force required to penetrate each sample. It can be seen that the standard deviation values are relatively large. The reason for this is primarily due to the structure of the dough. Air bubbles of very different sizes and distributions are present in each sample. In addition, the surface of the donuts is relatively uneven. Different freezing times and different ways of thawing had different effects on different samples, but the statistical analysis revealed that the maximum force required to penetrate the samples tested before freezing was significantly different from the samples tested after freezing ($F_{max,\ time}$ (F(23;216)=15.317; p<0.0001). In addition, the baking medium and the material of the dough also had a significant effect on the maximum force ($F_{max,\ oil}$ (F(23;216)=14.656; p<0.0001), $F_{max,\ dough}$ (F(23;216)=31.714; p<0.0001)).

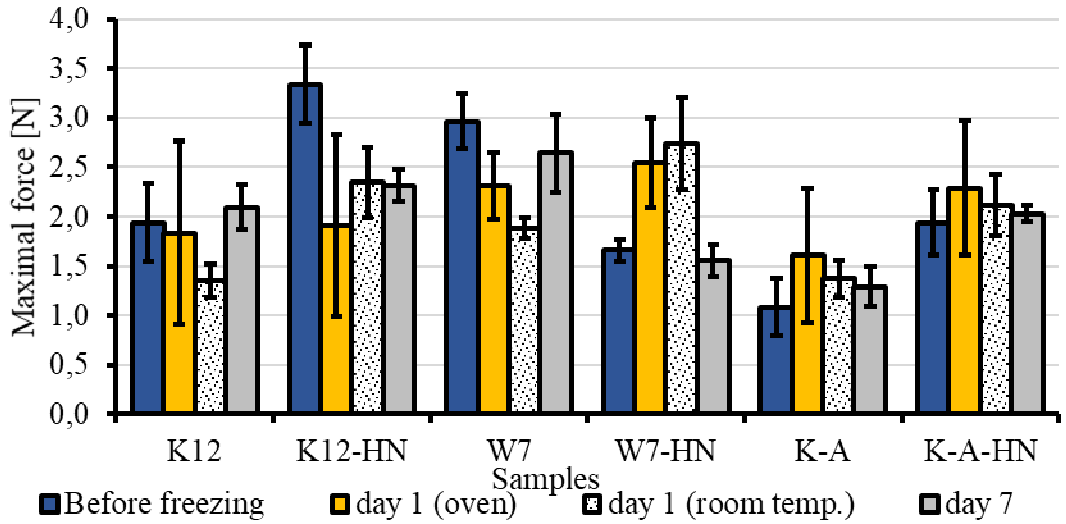

Figure 2. Maximal force of penetration of donuts before freezing, one day after cryogenic freezing thawed in oven for 7 minutes at 200°C (day 1 (oven)), and thawed at room temperature (day 1 (room temp.)) and after 7 days of storage at -18°C (day 7)

The value of penetration work (*Figure 3*) expresses all the work required to penetrate the probe in donut samples. There is no clear trend in the development of penetration work, but it can be said that there is a significant difference ($W_{pen,,\ time}$ ($F(23;216)=10.532$; $p<0.0001$)) between the data measured before freezing and the measured data after freezing. In addition, the penetration work done in the traditional dough differs from the other two and the baking medium had also significant effect on the penetration work ($W_{pen,\ oil}$ ($F(23;216)=113.794$; $p<0.0001$), $W_{pen,\ dough}$ ($F(23;216)=24.605$; $p<0.0001$)).

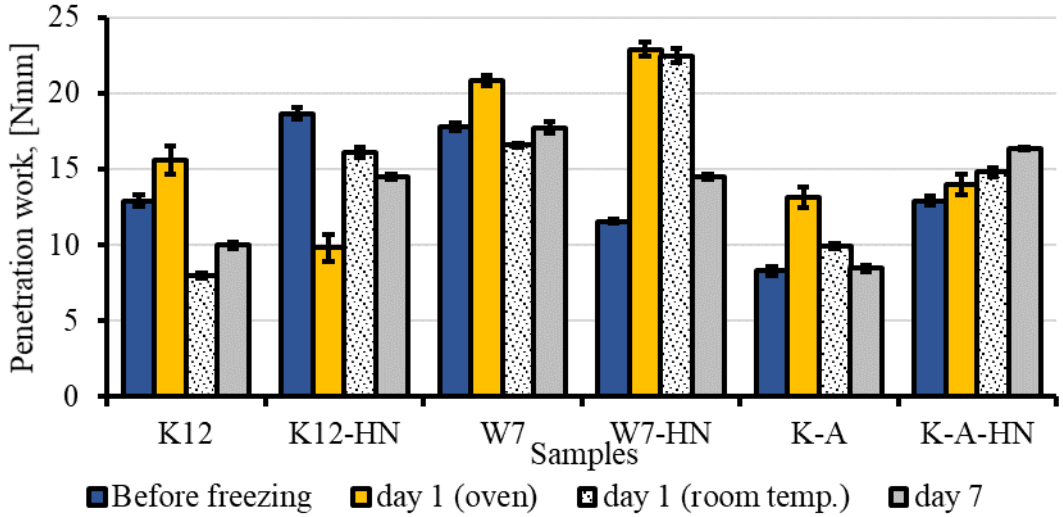

Figure 4. Penetration work of donut samples before freezing, one day after cryogenic freezing thawed in oven for 7 minutes at 200°C (day 1 (oven)), and thawed at room temperature (day 1 (room temp.)) and after 7 days of storage at -18°C (day 7)

Results of sensory evaluation

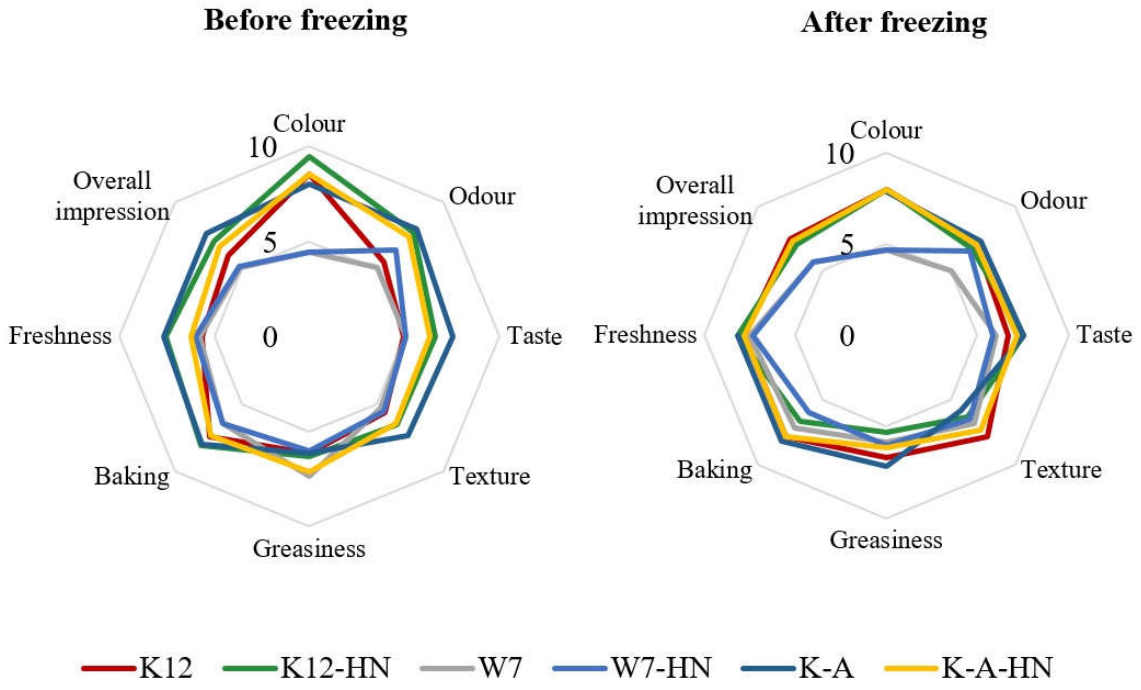

Figure 5. Results of sensory evaluation before freezing and after cryogenic freezing and thawing in oven after 1 day

Results of the sensory analysis performed with consumers can be seen in *figure 5*. Sample W7-HN received the lowest score for all aspects before freezing. In contrast, the K12-HN and K-A samples showed good organoleptic properties. In contrast, on the first day after freezing, samples received much better score values. The reason for this is probably due to the fact that the donuts were released in a hot oven at 200 °C for 7 minutes before the judgment. Thawing in oven influenced positively the surface structure of the product, the samples received a fresh, crunchy texture, and a relatively large amount of fat and oil was poured out of the donut pastries, so the fatty feeling decreased for the donuts.

CONCLUSIONS

We found that freezing in liquid nitrogen changed the texture properties of donut samples. However, it did not cause the decrease of popularity of products based on the consumer sensory evaluation. The results show that freezing decreased water activity of products. Further microbiological and sensory tests are needed to determine the shelf life of there products.

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COMPETITIVENESS OF MEAT AND ASSOCIATED PRODUCTS IN INTERNATIONAL TRADE

ATTILA JAMBOR

Corvinus University of Budapest
Department of Agricultural Economics and Rural Development
1093 Budapest Fővám tér 8.
attila.jambor@uni-corvinus.hu

ABSTRACT
There has been considerable growth in global meat trade recently in line with globally increasing population and changing diets. The paper analyses competitiveness patterns in global meat trade between 1989 and 2018. The article applies the method of revealed comparative advantages on global meat trade data and reaches a number of conclusions. First, results show top 10 countries in global meat exports and imports as well as most traded products. Global meat exports are dominated by the United States, Brazil and the Netherlands, whole main meat importers were Japan, Germany and the United Kingdom. The paper shows that global meat trade is highly concentrated by country and product but this concentration has decreased considerably in the previous 20 years. By analysing specialisation in global meat trade, a diverse picture becomes apparent where export positions and comparative advantages are not always moving together. Last but not least, Hungarian positions are also analysed in context throughout the paper.

Keywords: competitiveness, comparative advantage, meat, trade

INTRODUCTION

Competitiveness is one of the most used word in economics, containing many kinds of different interpretations. One strand of the literature combines international trade theories with macro level competitiveness and argues that competitiveness of nations can be interpreted and measured via trade based indices. BALASSA (1965) was one of the early supporters of this theory, elaborating his famous index of revealed comparative advantages. Since this seminal work, a vast amount of literature is dedicated to the analyses of revealed comparative advantages of global trade.

The analysis of comparative advantages of agricultural and food products is limited in the international literature. In a regional context, CHINGARANDE (2013) investigated the comparative advantage of the East-African Community (EAC) Member States and found advantage for some agricultural products such as green tea, coffee, ivory, fish fillet, and flowers. AKMAL ET AL. (2014) analysed the competitiveness of Pakistan's basmati rice exports and found that the country was losing its position to world markets in one of its biggest export products, calling for a change in its trade strategy. ASTANEH ET AL. (2014) searched for comparative advantage in Iran's stone fruits market and found that the country had strengthened her competitive positions, though it lacked comparative advantage in the majority of the years analysed.

In Europe, BOJNEC AND FERTŐ (2014) analysed the competitiveness of agri-food exports of European countries, and found majority of countries and products to have an advantage globally. The most successful nations in this regard were the Netherlands, France and Spain. The article also predicted a more long lasting advantage for Western-European countries, compared to Eastern-European ones. FERTŐ (2008) analysed the evolution of agri-food trade patterns in Central European Countries and found the trade specialization

across the region to be mixed. For particular product groups, greater variation was observed, with stable (unstable) patterns for product groups with comparative disadvantage (advantage). TÖRÖK AND JÁMBOR (2013) also analysed the agri-food trade patterns of New Member States, and highlighted that almost all countries experienced a decrease in their comparative advantage after the EU accession, though it still remained at an acceptable level for most cases.

In the Americas, KORINEK AND MELATOS (2009) analysed revealed comparative advantages of MERCOSUR countries and found margarine, vegetable oils and coffee as the most competitive products in 1988 to 2004. In particular, Brazil and Argentina are leaders in comparative advantage in beef, both in fresh and preserved form. Moreover, SPARLING AND THOMPSON (2011) investigated the Canadian agri-food sector and concluded that despite its overall competitiveness, the country was losing its position in food processing. SARKER AND RATNASENA (2014) analysed the comparative advantages of Canadian wheat, beef and pork sectors between 1961 and 2011, and found only the wheat sector to be competitive.

DISDIER ET AL. (2015) analyzed comparative advantages of agri-food products in the Asian and Pacific region and found that Australia and New Zealand had strong comparative advantages in fruit and vegetables, beverages and the dairy market.

Despite the apparent importance of the topic, however, the majority of studies are focused on industrial products. JAMBOR AND BABU (2016) were the first to make an overview on global agri-food trade competitiveness. This paper analyses revealed comparative advantages in global meat trade and in doing so, contributes to the existing literature in two ways. First, it applies the theory of revealed comparative advantages on an important agricultural product group. Second, it analyses global trade flows instead of regional or national ones.

MATERIAL AND METHOD

Probably the most well-known index analysing trade-based competitiveness of nations is Revealed Comparative Advantage (RCA), calculating the proportion of a country's share of exports for a single commodity to the exports of all commodities and the similar share for a group of selected countries, expressed by BALASSA (1965) as follows:

$$\mathrm{RCA_{ij}} = \left(\frac{X_{ij}}{X_{it}} \right) \Big/ \left(\frac{X_{nj}}{X_{nt}} \right) \tag{1}$$

where, X means export, i indicates a given country, j is a given product, t is a group of products and n is the group of selected countries. Hence, a revealed comparative advantage (or disadvantage) index of exports can be calculated by comparing a given country's export share by its total exports, with the export share by total exports of a reference group of countries. If RCA>1, a given country has a comparative advantage compared to the reference countries, or in contrast, a revealed comparative disadvantage if RCA<1. Although the Balassa (RCA)-index is criticized from many aspects, it is beyond the scope of this paper to go into details – see Jambor and Babu (2016) for a thorough review on this issue.

In order to calculate the index above, the article uses the World Bank WITS software based on COMTRADE, an international trade database developed by the United Nations at the HS six digit level as a source of raw data. Meat trade is defined as trade in HS02 products. The chapter works with trade data for the period of 1989 to 2018.

RESULTS

Global meat export has been continuously increasing in the previous 30 years with 10 countries giving the majority of products traded (*Figure 1*). The United States, Brazil and the Netherlands were the biggest meat exporters in 1989-2018, accounting for 30% of global meat export on average. The case of Spain and Brazil should be highlighted here as they were the countries increasing the export of meat products by 17 and 15 times between 1989-1993 and 2014-2018, respectively. Hungary was giving less than a percent of global meat exports in 1989-2018.

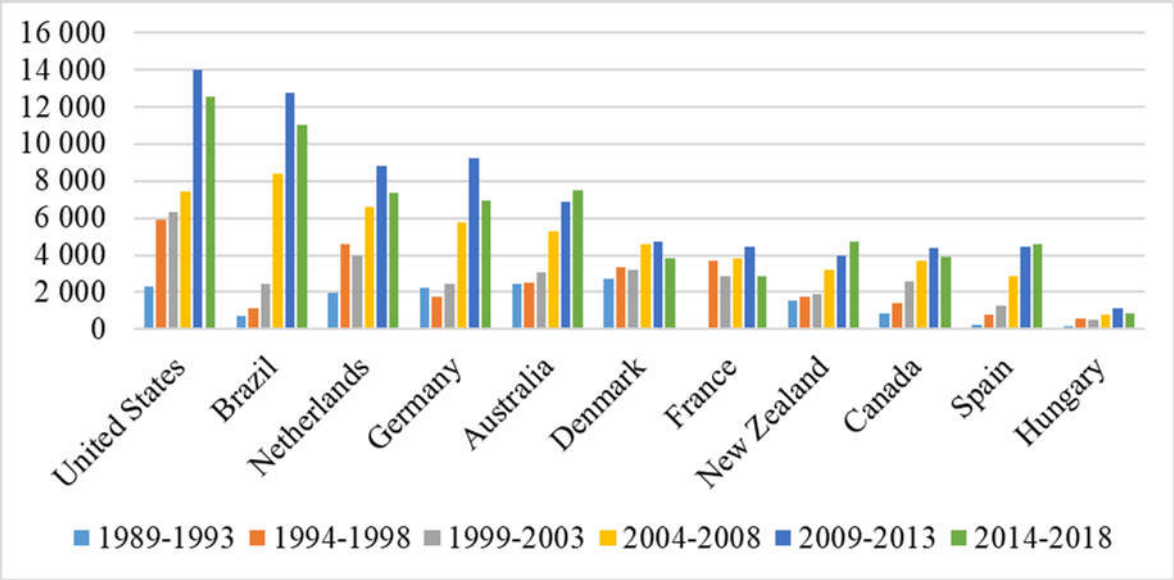

Figure 1. Meat exports of the most important market players and Hungary, 1989-2018, million USD based on World Bank (2019) data

As to global meat import, Japan, Germany and the United Kingdom were the major players, giving almost a third of the import of global meat and associated products (*Figure 2*). Although all countries have increased meat import to some extent in the period analysed, the case of China is amazing in this regard: from 1989-1993 to 2014-2018, China increased its meat import by almost 260 times! In the meantime, Hungary also experienced a significant 30 times growth in its meat import – however, this is still less than 0.5% of global meat traded.

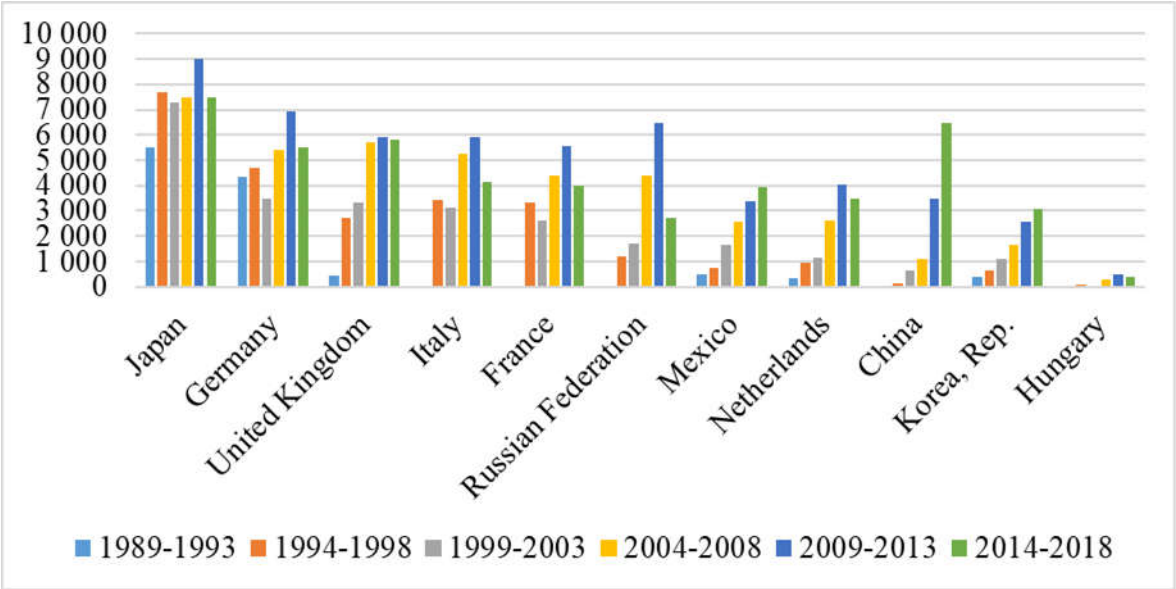

Figure 2. Meat imports of the most important market players and Hungary, 1989-2018, million USD based on World Bank (2019) data

With calculation of Balassa indices, competitiveness patterns of global meat trade becomes apparent (*Table 1*). It is obvious that New Zealand, Brazil and Australia had the highest Balassa indices in 2014-2018 with all the major exporters but Germany having some comparative advantage in the whole period. Brazil experienced the biggest growth in meat trade competitiveness the period analysed, while Hungary showed the biggest fall. Comparative advantages of New Zealand and Australia is mainly based on goat, sheep and lamb trade, while Brazil seems to have excelled in frozen chicken, swine and bovine meats. It is also evident from Table 1 that biggest exporters of meat in value terms are not necessarily the most competitive countries globally.

Table 1. Balassa indices for meat products of the most important market players and Hungary, 1989-2018, based on World Bank (2019) data

Country	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018
United States	0.80	0.87	0.99	0.79	1.03	1.03
Brazil	1.94	1.64	3.50	4.55	4.16	4.25
Netherlands	2.44	2.11	1.58	1.32	1.23	1.38
Germany	0.39	0.27	0.42	0.51	0.65	0.54
Australia	7.00	7.62	8.65	8.89	6.64	7.63
Denmark	5.32	4.43	4.27	3.34	3.08	2.68
France	n.a.	1.33	1.34	1.38	1.34	1.16
New Zealand	21.15	30.76	34.18	36.58	31.10	26.50
Canada	0.56	0.60	0.81	0.84	0.93	1.02
Spain	0.74	1.00	1.61	1.85	1.86	2.05
Hungary	15.48	10.68	5.97	3.37	3.12	2.75

CONCLUSIONS

Results above suggest that the global meat market has considerably changed in the previous 30 years. In general, concentration by export and import decreased, suggesting that meat trade is made by an increasing amount of market players. Meat is mainly produced and traded among developed countries with changing roles in the global market.

According to the Balassa indices, New Zealand, Australia and Brazil were the most competitive countries in global meat exports in the previous 30 years with Brazil leading the line in competitiveness growth. It seems evident that little relationship exists between export values and competitiveness.

Although the methodology has a number of limitations, results show an interesting picture of global meat trade on the long run. Future research might focus on the determinants of changes behind together with comparing trade and competitiveness of other industries with the example above.

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ANALYSIS OF GAME DAMAGE ESTIMATION METHODS IN WINTER WHEAT (*TRITICUM AESTIVUM*) THRUOGH GIS SIMULATIONS

IMRE KOVÁCS, ANDREA SZABÓ, GERGELY SCHALLY, SÁNDOR CSÁNYI, NORBERT BLEIER

Szent István University, Institute for Wildlife Conservation
H-2100 Gödöllő, Páter K. str. 1.
Imre.Kovacs@hallgato.szie.hu

ABSTRACT
Wildlife damage to agriculture causes significant economic loss worldwide annually. Game managers or hunters are responsible for the financial compensation of the crop damage caused by game species in several countries, including Hungary. Accredited experts estimate the level of the damage; however, currently, there are no standardised methods that would be obligatory to apply. In order to obtain information on the accuracy and bias of the different sampling methods, we designed GIS simulations in winter wheat (*Triticum aestivum*), which covers a significant proportion of the arable land not only in Hungary, but also globally.
We tested two sampling methods with three sampling plot arrangements in a GIS environment. Our questions were the following: (1) How accurate and biased are the examined samplings? (2) Does the rate or the spatial distribution of the damage (or the interaction of these factors) affect the results of the investigated methods?
We created 15 wheat field models with 1:2 side ratio, 12 cm row width and the area of 3 ha. We simulated 5 damage rates (10%, 30%, 50%, 70%, 90%) and 3 spatial damage patterns [random, aggregated in 1 and 2 field edges], of which the latter two follow the actual pattern of crop damage caused by big game species. V, W and X sampling tracks were allocated on each field model, and then they were sampled with square shaped, 1 m^2 quadrats and 1 m long row sections (with 5 repetitions). The sample size was 20 and 25 plots, respectively (determined by the original description of the methods). At the sample plots, the total number of plants and the number of damaged plants were counted. According to our results, the statistical parameters of the different samplings were similar; the difference between the best and the poorest values was low. The rate and spatial distribution of the damage, as well as their interaction, had a significant effect on the estimation of each quadrat sampling, while the row sections were significantly affected only by the damage distribution (V and W tracks) or the damage rate (X track). According to our findings however, the difference between the labour-intensity of the two approaches can be decisive. With the sample sizes in our study, remarkably lower number of plants had to be examined along the row sections, than in the quadrats. This suggests that the experts can obtain similar quality results with less effort, if they choose the row section sampling over the quadrats.

Keywords: Winter wheat, *Triticum aestivum*, game damage, sampling, damage estimation

INTRODUCTION

Wildlife damage to agriculture causes significant economic loss worldwide annually (CONOVER, 2002; CSÁNYI, 2018; MAILLARD *et al.,* 2010; PUTMAN, 2010). According to the legislation, the game managers or hunters are responsible for the financial compensation of the crop damage caused by game species in several countries (FINDO and SKUBAN, 2010; FRĄCKOWIAK *et al.,* 2013; MAILLARD *et al.,* 2010), including Hungary (BLEIER *et al.,* 2012a, 2012b). Accredited experts estimate the level of the damage (Act LV., 1996: Act on Game Conservation, Management and Hunting); however – currently – there are no standardised methods that would be obligatory to apply. Due to the lack of studies on the accuracy and bias of the different sampling methods, the experts are often not able to choose among them on a scientifically sound basis (BALÁZS, 2011; BLEIER, 2014). In order to support them with relevant results, we designed GIS simulations in winter wheat (*Triticum aestivum*), which covers a significant proportion of the arable land not only in

Hungary but also globally. As several game species [e.g. Wild boar (*Sus scrofa*), Red deer (*Cervus elaphus*) and Brown hare (*Lepus europaeus*)] cause damage to the wheat, it is an essential plant species regarding the game damage estimation.
In the present study, we tested two sampling methods with three sampling plot arrangements in a GIS environment. Our questions were the following: (1) How accurate and biased are the examined samplings? (2) Does the rate or the spatial distribution of the damage (or the interaction of these factors) affect the results of the investigated methods?

MATERIAL AND METHOD

For the GIS simulations we created 15 wheat field models with 1:2 side ratio and the area of 3 ha. The field models were based on a point grid with 12 cm row width and 5,000,000 wheat grains/ha (VARGA and KÁSA, 2011), therefore the initial number of points was 14,976,028. In order to simulate the incomplete germination, we deleted a randomly selected 15% of the points (JAMES and LLOYD, 1995), therefore the total number of points used in the actual work was 12,729,624.
We simulated 5 damage rates (10%, 30%, 50%, 70%, 90%) and 3 spatial damage patterns (random, aggregated in 1 and 2 field edges – *Figure 1*). The aggregated setup simulates the effect of a neighbouring forest on the actual pattern of crop damage caused by big game species based on previous field studies (BLEIER *et al.,* 2006, BLEIER *et al.,* 2017, CAI *et al.,* 2008, DEVAULT *et al.,* 2007, HOFMAN-KAMIŃSKA and KOWALCZYK, 2012, THURJFELL *et al.,* 2009). In or study, we created 30 m wide buffer zones along 1 or 2 edges of the field, in which we allocated min. 80% of the damaged plants. Where the total number of plants in the buffer zone was less than the 80% of the damaged plants, the buffer zones were considered as entirely damaged areas.

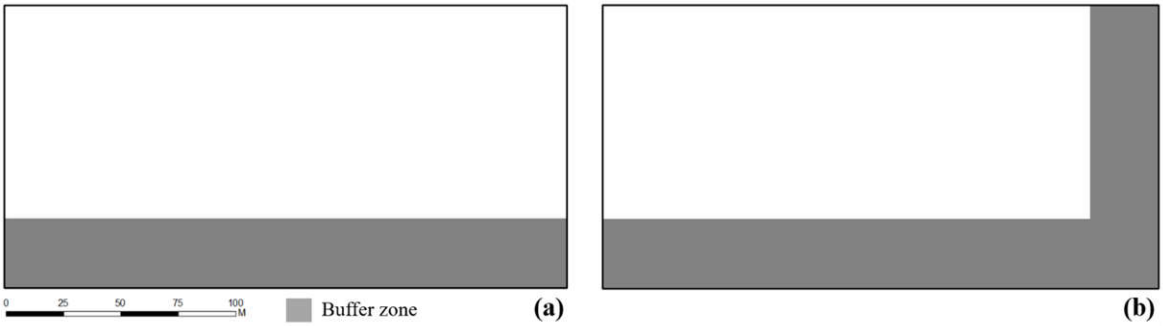

Figure 1. Simulated spatial patterns of damage distribution: aggregated in 1 (a) and 2 (b) field edges

V, W and X sampling tracks (*Figure 2*) were allocated on each field model, and then they were sampled with square shaped, 1 m^2 quadrats and 1 m long row sections. The sample size was 20 and 25 plots, respectively (determined by the original description of the methods: KLÁTYIK, 2003, KIRÁLY and MAROSÁN, 2016). At the sample plots, the total number of plants and the number of damaged plants were counted. The damage rate was calculated as ($\sum$ DP / $\sum$ TP) X 100, where DP was the number of recorded damaged plants and TP was the total number of wheat individuals observed.

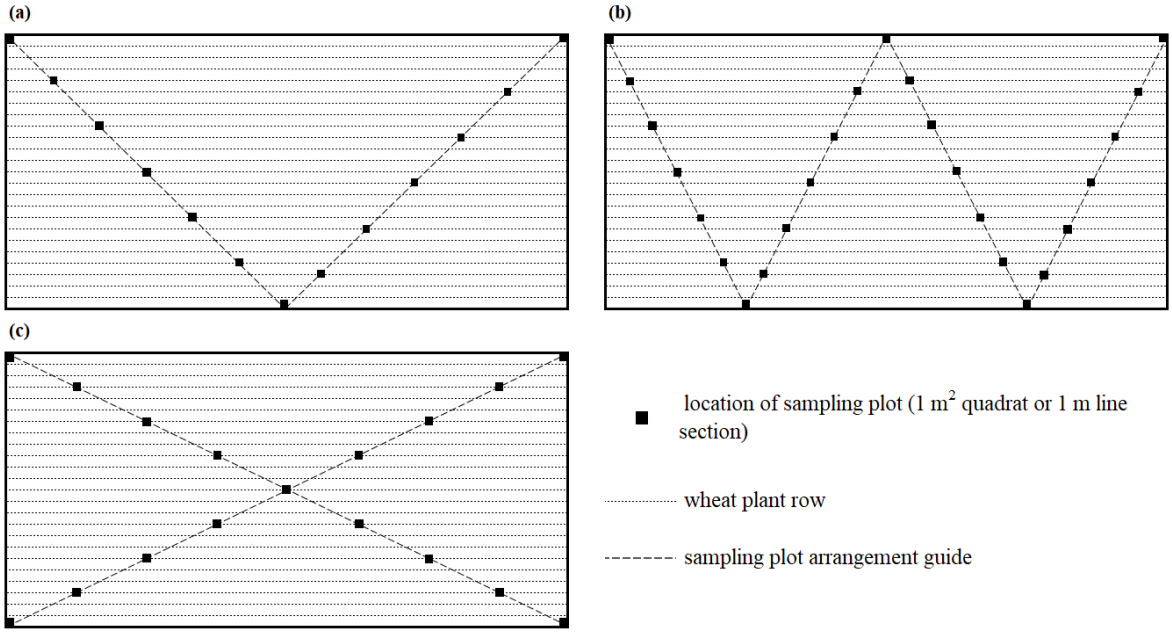

Figure 1. Arrangement patterns and schematic locations of the quadrats: V (a), W (b), X (c)

In order to simulate the differences in the samplings conducted by different experts in a real-life situation, we performed 5 repetitions of the samplings on each field model with each method. To repeat the samplings, we relocated the quadrats and line sections. This meant slipping each plot to the same distance and direction (e.g. with 1 m or 1 row upwards), which allowed us to keep the original spatial arrangement of the sampling.
We characterised the estimations by the Mean Squared Error (MSE), the Standard Error (SE) and the bias. Before calculating means for these statistical parameters, we tested the normality of the data of each 5 repetition groups with Kolmogorov-Smirnov test. Two-way ANOVA was conducted to identify the factors (true damage rate, spatial distribution of the damage or the interaction of these two values) that have a significant impact on the Percentage Relative Bias (PRB) of the estimations. Pairwise comparisons were performed with Tukey post-hoc test.
The GIS simulations were conducted in QGIS 2.18 Las Palmas (QGIS Development Team, Open Source Geospatial Foundation Project). In the statistical analysis we used R v2.15 (R Development Core Team) software.

RESULTS

Considering the single estimations, the difference from the true damage rate varied between -4.9% (1 m line sections with V arrangement, 30% true damage rate, damage aggregated 1 field edge) and 5.4% (1 m^2 quadrats with X arrangement, 30% true damage rate, damage aggregated 1 field edge).
In terms of the calculated parameters (*Table 1*), the quadrat sampling with W arrangement provided the majority of best values in the case of each parameter (expected value: 27% of the best values, MSE: 40%, SE: 47%, bias: 27). Overall, the quadrats with X arrangement provided most (60%) of the worst values in the case of the estimated damage rate and bias, while the majority of the poorest values of the SE (67%) and MSE (40%) were resulted by line section sampling with V arrangement.

It should be noted that since the bias and mean damage rate values are in direct connection, these two parameters always show the same method as best and as worst in case of each spatial damage pattern and damage rate combination.
It is interesting to mention that in the case of SE, only best or neutral values were obtained with the quadrat samplings, while the line section sampling resulted only the poorest or neutral values.

Table 1. Damage estimation, MSE, SE and bias of the investigated methods (black background: best values; gray background: poorest values)

Damage distribution			Random					Aggregated in 1 field edge					Aggregated in 2 field edges				
True damage rate (%)			10	30	50	70	90	10	30	50	70	90	10	30	50	70	90
Estimated damage (expected value)	1 m² quadrats	V	10.11	30.16	50.15	69.76	90.14	8.87	25.65	47.31	68.28	89.38	10.32	31.05	50.99	70.38	90.22
		W	10.01	29.84	50.06	69.93	89.82	8.73	25.79	46.82	68.49	89.16	10.14	30.91	51.02	70.79	90.10
		X	10.14	30.23	50.34	70.17	89.99	11.78	34.78	53.22	71.97	90.47	11.17	33.82	54.16	72.52	90.67
	1 m line sections	V	10.11	29.98	49.87	70.63	89.64	8.67	25.74	47.16	68.23	89.00	9.43	29.54	48.90	68.76	90.22
		W	9.37	29.38	49.66	70.12	90.16	9.47	29.91	49.44	70.28	90.44	10.70	31.74	51.35	71.54	90.61
		X	9.81	29.06	50.43	69.65	89.66	9.19	29.39	49.34	70.11	89.61	9.78	29.46	48.96	70.43	90.03
MSE	1 m² quadrats	V	0.10	0.29	0.52	0.25	0.03	1.33	19.24	7.45	3.75	0.48	0.13	1.26	1.09	0.34	0.11
		W	0.08	0.18	0.05	0.03	0.07	1.66	17.83	10.29	2.69	0.72	0.05	0.98	1.21	0.81	0.04
		X	0.06	0.49	0.30	0.19	0.21	3.35	22.93	10.65	4.17	0.23	1.48	14.65	17.43	6.40	0.52
	1 m line sections	V	0.60	2.94	1.57	3.38	0.64	3.94	18.40	9.00	5.21	2.50	2.24	1.43	2.10	4.62	0.16
		W	0.94	2.00	1.68	0.42	0.38	0.91	0.42	2.13	1.72	0.50	2.14	3.30	2.77	2.91	0.98
		X	0.54	2.95	1.08	1.25	0.29	1.15	0.97	1.28	0.77	0.47	0.27	1.50	1.43	0.50	0.42
SE	1 m² quadrats	V	0.34	0.57	0.79	0.49	0.09	0.28	0.60	0.52	0.99	0.35	0.17	0.45	0.38	0.49	0.28
		W	0.31	0.43	0.24	0.18	0.21	0.24	0.40	0.44	0.73	0.13	0.18	0.43	0.48	0.48	0.21
		X	0.22	0.74	0.48	0.45	0.51	0.49	0.39	0.58	0.61	0.13	0.37	0.25	0.34	0.30	0.31
	1 m line sections	V	0.86	1.92	1.39	1.93	0.79	1.64	0.59	1.08	1.62	1.37	1.54	1.24	1.05	1.97	0.38
		W	0.82	1.42	1.40	0.72	0.67	0.89	0.72	1.50	1.43	0.62	1.43	0.59	1.09	0.82	0.88
		X	0.80	1.61	1.06	1.18	0.47	0.78	0.87	1.03	0.98	0.63	0.53	1.23	0.66	0.63	0.72
bias	1 m² quadrats	V	0.11	0.16	0.15	-0.24	0.14	-1.13	-4.35	-2.69	-1.72	-0.62	0.32	1.05	0.99	0.38	0.22
		W	0.01	-0.16	0.06	-0.07	-0.18	-1.27	-4.21	-3.18	-1.51	-0.84	0.14	0.91	1.02	0.79	0.10
		X	0.14	0.23	0.34	0.17	-0.01	1.78	4.78	3.22	1.97	0.47	1.17	3.82	4.16	2.52	0.67
	1 m line sections	V	0.11	-0.02	-0.13	0.63	-0.36	-1.33	-4.26	-2.84	-1.77	-1.00	-0.57	-0.46	-1.10	-1.24	0.22
		W	-0.63	-0.62	-0.34	0.12	0.16	-0.53	-0.09	-0.56	0.28	0.44	0.70	1.74	1.35	1.54	0.61
		X	-0.19	-0.94	0.43	-0.35	-0.34	-0.81	-0.61	-0.66	0.11	-0.39	-0.22	-0.54	-1.04	0.43	0.03

According to the two-way ANOVA, the rate and the spatial distribution of the damage, as well as the interaction of these factors had a significant effect on the PRB of the quadrat samplings with each spatial arrangements. The PRB of the line section samplings was affected only by the spatial damage distribution (V and W arrangement) or the true damage rate (X arrangement) (*Table 2*). The Tukey post-hoc test did not reveal any patterns, the significant differences distributed variably among the pairwise comparisons.

Table 2. Estimation affecting factors based on two-way ANOVA (*p<0.001; **p<0.01; *p<0.05)**

Sampling method		Damage rate	Spatial damage distribution	Rate-distribution interaction
1 m² quadrats	V	F4=10.511***	F2=206.120***	F8=29.592***
	W	F4=23.654***	F2=284.021***	F8=36.216***
	X	F4=79.576***	F2=128.189***	F8=19.432***
1 m line sections	V	NS	F2=8.3238***	NS
	W	NS	F2=8.0766***	NS
	X	F4=2.9341*	NS	NS

CONCLUSIONS

Based on our results, we cannot conclude that any of the examined samplings would be able to provide remarkably better quality results in general. Consistent under- or overestimations (when each 5 repetitions shows difference from the true damage rate in the same direction) were also present in the case of both approaches. After analysing multiple different statistical parameters, we found that it is variable that which sampling results the best and the poorest values in the different damage rate and spatial distribution scenarios. For example, based on the calculated parameters (expected value, SE, MSE, bias), the 1 m^2 quadrats provided the best values more often than the 1 m line sections, but on the other hand, the absolute difference (without ranking) between the performance of the samplings was often low. Moreover, the PRB of the line section samplings proved to be affected by less factors than the same parameter of the quadrat estimations.
In summary, we found the applicability of the two estimation principles (quadrats and line sections) and the three sampling plot arrangements generally similar, which means that one should look for further aspects to support the selection among the available sampling approaches. The experts have to consider the sampling efforts (ENGEMAN and STERNER, 2002), therefore the difference between the labour-intensity of the two approaches can be decisive. In the present study, remarkably lower number of plants (approx. 15% with the current exact simulated field area and sample sizes) had to be examined along the row sections, than in the quadrats. This suggests that the experts can obtain similar quality results with less effort, if they choose the row section sampling over the quadrats.

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EFFECT OF DIFFERENT LEVELS OF FERTILIZERS AND FORECROPS ON RHEOLOGICAL PROPERTIES OF WINTER WHEAT

Zoltán Magyar [1] – Péter Pepó [1] – Ernő Gyimes [2]

[1] University of Debrecen, Kerpely Kálmán Doctoral School
[2] University of Szeged, Faculty of Engineering, Institute of Food engineering
e-mail: magyarzoltan93@gmail.com

ABSTRACT
During our experiments in 2017/2018 crop year at Látókép Experimental Farm of University of Debrecen we studied the effect of different forecrops (sweet corn, sunflower) and increased dosages of artificial fertilizers (control, $N_{90}PK$, $N_{150}PK$) on rheological properties of wheat. Both levels of artificial fertilizers significantly improved valorigraphic water absorption (WA), quality number (VQN) and dough-stability (DST), moreover alveographic L and W value. Applying artificial fertilizers valorigraphic mixing-tolerance (DMT) and dough softening (DS) values were decreased significantly comparing to the control ones. Sweet corn as a forecrop had significantly favourable effect on VQN, DDT, DST, DS and DMT; promylographic ductility; alveographic L values comparing to sunflower. Fertilizing x forecrop interaction affected in a significant way the DMT and P/L value. In addition, fertilizing x cultivar interaction had significant effect on alveographic L, promylographic ductility and ratio. Using Pearson's correlation analysis results, fertilizer dosages were in strong positive correlation with VQN and DDT; alveographic L and W. The alveographic W was in strong positive correlation with promylographic energy (r=0,842**) and DST (r=0,863**), while the L was in medium positive correlation with promylographic ductility (r=0,744**). Our results proved that, the wheat flour's rheological parameters are significantly affected by fertilizing dose, forecrop and cultivar.

Keywords: wheat, rheological parameters, agrotechnical elements, valorigraph, alveograph

INTRODUCTION

Wheat flour is playing a very important role in our daily diet, which is the basic material of many industries, like bakery, confectionary and pasta industry extending to animal feed as well (RAGASITS, 1989). Quality parameters of wheat can be affected by many agrotechnical factors (ERDEI AND SZÁNIEL, 1975). The real quality value of wheat is expressed during processing (POLLHAMERNÉ, 1981), that can be predicted by testing samples with different rheological measurements, like valorigraph, farinograph, alveograph, promylograph or extensograph. Using these techniques kneading properties, water absorption, flexibility and strength of dough can be tested.
The yield and the quality of wheat can be greatly affected by forecrop, which is favourable if it does not exploit nutrient and water supplies of the soil (RAGASITS, 1989). Considering the agrotechnical factors, one of the most important is the proper nutritional supply, which can be achieved by artificial fertilizing (GYŐRI AND GYŐRINÉ, 1998). The usage of artificial fertilizers is affected by the nutrient reactionary properties of the cultivated wheat genotypes (PEPÓ, 2011), as a result the basic condition of economical wheat production is the selection of proper genotype (ÁGOSTON AND PEPÓ, 2005).
Good quality flour means the following for the baking industry: good water absorption capability, appropriate dough elasticity, shape-holding and gas-holding ability (Erdei and Szániel, 1975). Rheological methods can be divided into two groups: 1) static methods, like alveograph, extensograph; 2) dynamic ones, like farinograph and valorigraph (SIPOS *ET AL.*, 2007). According to PEPÓ (2002) the average of 4-year data GK Öthalom wheat genotype's VQN was increased by 9, the wet gluten content was increased by 5% with the usage of 120kg NPK fertilizer dosage. The genotype properties had medium significant

effect on WA, QN, DST and DS (TANÁCS AND GERŐ, 2003). DDT and DST were significantly affected by genotype and year effect, stated by ZECEVIC *ET AL*. (2013). Nitrogen fertilizing significantly increased P (MATUZ *ET AL*., 2007), WA and DDT values (LININA *ET AL*., 2014).

Crude protein content had medium correlation with DST (KOPPEL AND INGVER, 2010). Fertilizing had significant correlation with alveographic values (GYŐRI *ET AL*., 2003). According to SIPOS *ET AL*. (2007) L value correlated positively in a significant extent with VQN, WG, CP and extensographic ductility, and negatively with DS. In a 4-year research TÓTH *ET AL*. (2007) declared that VQN had tight correlation with W. The extensographic ductility had tight correlation with WG, CP, QN and W (SIPOS *ET AL*., 2007).

MATERIAL AND METHOD

The experiment was set up at Látókép Experimental Farm of University of Debrecen in the 2017/2018 growing season, which has a chernozem soil type. The area has medium humus content, medium phosphorus and potassium supply and neutral pH. The forecrops of the experiment were sweet corn and sunflower. The effect of three fertilizer levels (control, $N_{90}P_{67,5}K_{79,5}$; $N_{150}P_{112,5}K_{132,5}$) were tested in 10 m^2 plots in 4 repetitions. The 50% of nitrogen and the whole amount of the phosphorus and potassium were applied in autumn, the remaining 50% of the nitrogen fertilizer was applied in spring as top dressing. Following two Hungarian winter wheat genotypes were tested: GK Öthalom and Mv Ispán. First the samples were treated by SLN Pfeuffer sample cleaner, then we conditioned them to 15.5% moisture content, lastly ground into flour with Brabender Quadrumat Senior laboratory mill. Crude protein contents (Kjeldahl method), wet gluten contents (ISO 21415-2:2015), valorigraphic (MSZ ISO 5530-3:1995), promylographic (Egger's Promylograph method) and alveographic (MSZ EN ISO 27971:2015) parameters were defined at the Institute of Food engineering, University of Szeged, Faculty of Engineering. Promylograph method is very similar to extensograph, where we made a 500-consistency dough, we rounded and moulded it, after that we let it to rest. The dough is measured after 45-90-135 minutes resting time.

For processing the results of the measurements IBM SPSS Statistics 22 program's one- and two-way ANOVA (with Tukey and Bonferroni posh-hoc tests) and Pearson's correlation analysis were performed. For graphical representation Python 3.7 version's Seaborn 0.9.0 library was used.

RESULTS

According to our results all the three factors (forecrop, fertilizer and cultivar) had significant effect on the measured rheological parameters. It can be seen, that the main parameters were between 22.73-54.81 (valorigraphic quality number, VQN, *Table 1*.), 107.80-312.73 (alveographic W, *Table 2*.) and 31.50-83.25 (promylographic energy, PE, *Table 3*.), which reflects well the unfavourable year effect of the 2017/2018 growing season. The crude protein was between 7.47-13.14%, the wet gluten content was between 16.06-29.25% (*Table 2*.). The lowest VQN, W and PE values belonged to GK Öthalom (sunflower, control), till then the highest VQN belonged to Mv Ispán (sweet corn, $N_{150}PK$), W and PE was got by Mv Ispán (sunflower, $N_{150}PK$).

Both levels of artificial fertilizers significantly improved valorigraphic water absorption (WA), VQN and dough-stability (DST), moreover alveographic L and W (*Figure 1*.) values. Beside these results, fertilizers increased significantly the valorigraphic dough-development time (DDT); alveographic P/L; promylographic ductility (PD), maximum resistance (PMR) and energy (PE) comparing to the control samples, which results

correlate well with LININA *et al.* (2014) findings. Applying artificial fertilizers valorigraphic mixing-tolerance (DMT) and dough softening (DS) values were decreased significantly comparing to the control ones.

Table 1. – **The effect of different forecrops and artificial fertilizers on the valographic parameters (Debrecen, 2018)**

Genotype	Forecrop	Treatments	VQN	WA	DDT	DST	DS	DMT	FQN
GK Öthalom	Sweet corn	control	33.09	53.68	1.38	2.63	155.00	107.50	23.25
	Sweet corn	$N_{90}PK$	44.77	56.38	2.00	7.13	130.00	82.50	39.50
	Sweet corn	$N_{150}PK$	49.47	57.06	2.25	8.50	117.50	68.75	49.50
	Sunflower	control	22.73	53.76	1.00	2.25	195.00	140.00	17.75
	Sunflower	$N_{90}PK$	41.73	55.42	1.75	6.25	138.75	82.50	37.00
	Sunflower	$N_{150}PK$	45.95	56.41	2.00	7.13	133.75	77.50	43.25
Mv Ispán	Sweet corn	control	34.80	58.17	1.13	3.13	145.00	107.50	24.50
	Sweet corn	$N_{90}PK$	49.60	61.33	2.25	8.00	122.50	67.50	52.25
	Sweet corn	$N_{150}PK$	54.81	61.75	2.50	8.75	107.50	50.00	61.25
	Sunflower	control	25.52	58.38	1.00	1.88	171.25	128.75	18.75
	Sunflower	$N_{90}PK$	44.23	61.05	1.63	6.38	131.25	70.00	37.00
	Sunflower	$N_{150}PK$	50.55	62.51	2.00	7.88	110.00	57.50	47.00

Abbreviation's explanation: VQN= valorigraphic quality number; WA= water absorption; DDT= dough development time; DST= dough stability; DS= dough softening; DMT= dough mixing tolerance; FQN= farinographic quality number

Table 2. – **The effect of different forecrops and artificial fertilizers on the alveographic parameters, protein and wet gluten content (Debrecen, 2018)**

Genotype	Forecrop	Treatments	P	L	P/L	W	WG	CP
GK Öthalom	Sweet corn	Control	63.55	51.43	1.24	119.75	16.65	8.79
	Sweet corn	$N_{90}PK$	64.53	94.25	0.70	207.63	25.19	12.04
	Sweet corn	$N_{150}PK$	67.68	108.63	0.63	240.85	28.26	13.14
	Sunflower	Control	73.90	36.60	2.02	107.80	16.65	7.47
	Sunflower	$N_{90}PK$	62.53	87.38	0.73	175.70	24.72	11.29
	Sunflower	$N_{150}PK$	62.03	101.18	0.61	200.70	29.25	12.45
Mv Ispán	Sweet corn	Control	89.65	52.38	1.80	167.10	20.69	9.56
	Sweet corn	$N_{90}PK$	92.18	83.83	1.11	249.15	27.08	12.03
	Sweet corn	$N_{150}PK$	95.93	87.05	1.11	272.45	28.82	12.84
	Sunflower	Control	116.75	34.40	3.42	132.30	16.06	8.25
	Sunflower	$N_{90}PK$	109.48	60.63	1.85	238.05	24.80	10.91
	Sunflower	$N_{150}PK$	117.95	75.33	1.57	312.73	27.59	12.03

Abbreviation's explanation: P= alveographic max. pressure; L= extensibility; P/L= curve's configuration; W= energy; WGC= wet gluten content; CP= crude protein content

Sweet corn as a forecrop had significantly favourable effect on VQN, DDT, DST, DS, DMT, PD and alveographic L value comparing to sunflower. Studying the cultivar effects, that can be stated Mv Ispán had significantly better WA, VQN, DS and DMT value; promylographic ductility resistance (PDR), PMR, PE and rate (PR); alveographic P, W and P/L value. Our measurements confirm *Pepó* (2011) findings, that different genotypes react in a different extent to fertilizer dosages.

Table 3. – **The effect of different forecrops and artificial fertilizers on the promylographic parameters (Debrecen, 2018)**

Genotype	Forecrop	Treatments	PDR	PD	PMR	PE	PR
GK Öthalom	Sweet corn	Control	286.3	93.5	294.5	39.8	3.1
	Sweet corn	$N_{90}PK$	374.0	118.3	455.3	70.3	3.2
	Sweet corn	$N_{150}PK$	382.0	119.3	478.3	72.3	3.2
	Sunflower	Control	211.3	102.5	214.3	31.5	2.1
	Sunflower	$N_{90}PK$	297.5	110.5	326.0	49.8	2.7
	Sunflower	$N_{150}PK$	285.5	113.0	315.0	49.3	2.5
Mv Ispán	Sweet corn	Control	370.3	97.8	394.5	51.8	3.9
	Sweet corn	$N_{90}PK$	332.0	116.5	409.0	61.8	2.9
	Sweet corn	$N_{150}PK$	360.5	123.8	447.5	72.5	2.9
	Sunflower	Control	463.3	82.3	469.0	50.5	5.6
	Sunflower	$N_{90}PK$	400.8	107.5	457.8	64.0	3.8
	Sunflower	$N_{150}PK$	436.3	119.5	556.5	83.3	3.7

Abbreviation's explanation: PDR= promylographic ductility resistance; PD= ductility; PMR= max. resistance; PE= energy; PR= ratio

Table 4. – **Correlation analysis between main quality parameters (Pearson' correlation analysis, Debrecen, 2018)**

	FT	WA	VQN	DDT	DST	DS	PDR	PD	PMR	PE	P	L	W
FT	1												
WA	,479**	1											
VQN	,857**	,579**	1										
DDT	,782**	,445**	,859**	1									
DST	,903**	,534**	,952**	,902**	1								
DS	-,756**	-,576**	-,948**	-,716**	-,839**	1							
PDR	.159	,525**	.229	.048	.185	-,362*	1						
PD	,735**	,362*	,731**	,752**	,785**	-,586**	-.117	1					
PMR	,399**	,652**	,488**	,320*	,457**	-,579**	,936**	.189	1				
PE	,642**	,669**	,727**	,591**	,719**	-,738**	,710**	,588**	,895**	1			
P	-.011	,768**	.070	-.043	.012	-.155	,581**	-.110	,550**	,375**	1		
L	,819**	.184	,794**	,772**	,829**	-,702**	.009	,744**	.247	,528**	-,383**	1	
W	,801**	,797**	,880**	,763**	,863**	-,846**	,393**	,721**	,650**	,842**	,398**	,638**	1

Abbreviation explanation: FT= fertilizer treatments; WA= water absorption; VQN= valorigraphic quality number; DDT= dough development time; DST= dough stability; DS= dough softening; PDR= promylographic ductility resistance; PD= prom. ductility; PMR= prom. max. resistance; PE= prom. energy; P= alveographic max. pressure; L= alv. extensibility; W= alv. energy

Fertilizing x forecrop interaction affected in a significant way the DMT and P/L value. In addition, fertilizing x cultivar interaction had significant effect on alveographic L, promylographic ductility and ratio. Using Pearson's correlation analysis results (*Table 4.*), fertilizer dosages were in strong positive correlation with VQN (0,857**), DST (0,903**), DDT (0,782**), alveographic L (0,819**) and W (0,801**), which results confirm *Győri et al.* (2003) consequences. The alveographic W was in strong positive correlation with VQN (0,880**), promylographic energy (0,842**) and DST (0,863**), while the L was in medium positive correlation with promylographic ductility (0,744**) and DST (0,829**), these results proved the statements of *Tóth et al.* (2007) and *Sipos et al.* (2007).

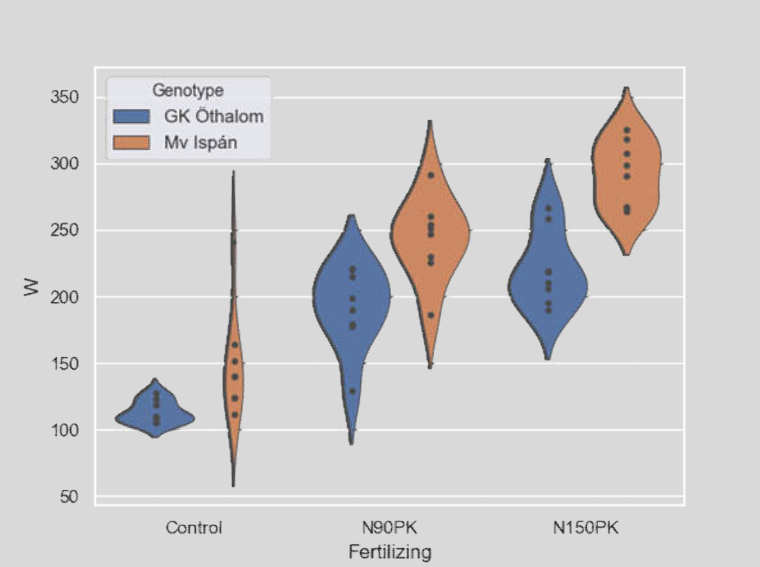

Figure 1. – **Alveographic W in the case of 3 fertilizer doses (Debrecen, 2018)**

CONCLUSIONS

Summarizing our results, the rheological parameters of wheat are significantly affected by fertilizer doses, forecrop and cultivar. On the basis of our researches sweet corn creates much more favourable conditions as a forecrop than sunflower, because the deep root system of sunflower exploits nutrient and water supplies of the soil. In the case of growing wheat for baking use, there is a need to put great emphasis on selecting the right cultivars and agrotechnology practices. In the future we will do the measurements in the next season as well, to extend our research with the year effect.

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THE EFFECT OF SUBSTRATES ON DIFFERENT CHARACTERISTICS OF *PHILODENDRON ERUBESCENS* CUTTINGS

MÁTÉ ÖRDÖGH

Department of Floriculture and Dendrology, Faculty of Horticultural Science, Szent István University, H-1118 Budapest, 29-43. Villányi Street, Hungary
ordogh.mate@kertk.szie.hu

ABSTRACT
Different substrates (BRT GreenMoss, perlite, white peat, coco coir, ASB Greenworld plant soil) were used during three cutting propagation trials of *Philodendron erubescens*, an ornamental climbing plant with attractive, large leaves. After examining morphological and physiological characteristics, I want to find the best substrates for the plants and ascertain the effects of substrates on the success of cutting propagation. As the results show, substrates, time of propagation and greenhouse temperatures also influenced certain parameters, especially shoot number. Warmer conditions (optimally 20-22 °C), optimal timing (cutting propagation: May, June, growing: summer) and effective substrates (BRT GreenMoss, ASB Greenworld plant soil or its combinations) resulted in the highest, largest values, mainly in the case of leaf length and width, shoot length, fresh green parts (leaves, shoots), total chlorophyll and carotenoid contents of leaves. Coco coir (and its mixture with BRT GreenMoss) also has positive effect on root and shoot development.

Keywords: *Philodendron*, cutting, substrates, plant characteristics

INTRODUCTION

Genus *Philodendron* is one of the largest groups belong to the *Araliaceae* family with almost 500 variably formed, epiphytic, hemiepiphytic or terrestrial species (BOYCE AND CROAT, 2012). The strong, robust climber *Philodendron erubescens* produces leathery, bright green leaves with reddish petiole and aerial roots on the nodes of the shoots. Leaves change shape as plants mature, young plants have smaller, heart-shaped ones, adult specimens develop larger, arrow-like leaves (ORLÓCI, 2014). *Philodendron*s can be propagated several ways (by seeds, micropropagation, etc.), and shoot cutting is one of the easiest and cheapest methods of multiplying climbing species, especially in nurseries (HAMRICK, 2003; JÁMBORNÉ AND DOBRÁNSZKI, 2005; TILLYNÉ MÁNDY AND HONFI, 2008). Well-drained, mildly acid (pH=6-6.5) soils are optimal for cutting propagation and growing of *Philodendron*s which usually contain peat plus other accessories for example peat+perlite or peat+sand (2:1) or 2:1:1 ratio of peat+tree bark+vermiculite (HAMRICK, 2003; MÁNDY ET AL., 2006). In this work, the aim was to find morphological and physiological differences between the rooted and survived cuttings and ascertain the effects of different substrates on the success of cutting propagation.

MATERIAL AND METHOD

Plant material, substrates, culture conditions

Cuttings of 10-15 cm in length with 2-3 leaves were collected from mother plants originated from previous micropropagation and acclimatization studies (ASZTALOS, 2012). Before planting soaked, cleaned cuttings were planted into containers of 9 x 9 cm size filled with every substrates (35 specimens per each group). The lower leaves were removed in order to avoid rot.

The first group was planted in 100% Novobalt white peat, BRT GreenMoss (rest on Sphagnum moss, originated from peat-moors of Finland – TILLY-MÁNDY AND HONFI, 2015), ASB Greenworld plant soil (henceforth: peat, BRT Moss, ASB soil), perlite, coco coir on 28th May 2015. Fifty-fifty percent combinations of BRT Moss plus the other 4 substrates were used for the second and third trials (which were started on 16th September 2015 and 3rd June 2016). The plants were grown in moderate greenhouse conditions without artificial lighting and with low heating during late autumn and winter, so the minimum temperature was only 6-12 °C during evenings of this period. In summertime, energy screen was used to avoid scorching of newly developed leaves and maintain optimal (20-22 °C) temperatures not more than 26-28 °C. As weekly (or during summer, daily) irrigation, heated (18-22 °C) tap water and as biweekly feeding, Substral fertilizer solution (NPK 6:3:6) were applied 2 months after planting of the cuttings.

Measurements of plant parameters

Three and a half months after starting, leaf width and length, length of shoots and roots, fresh weight of green parts and roots were measured, number of new shoots and roots were counted and physiological examinations (total chlorophyll, carotenoid content, peroxidase enzyme activity of leaves) were done.

For the determination of total chlorophyll and carotenoid content, 100 mg leaf sample was used (three times per group). Leaves were destructed by a dash of quartz sand and 10 ml acetone (80%). After one day cooling on +4 °C, absorbance of solution was measured by GeneSys VIS-10 (Thermo Fisher Scientific Inc., USA) spectrophotometer at 644, 663 and 480 nm wavelength. Leaf pigment contents ($\mu g\ g^{-1}$) were calculated by formula ($20.2 \times A644 + 8.02 \times A663) \times V/w$ and ($5.01 \times A_{480}$)/w; where V= volume of tissue extract (10 ml), w= fresh weight of tissue (0.1 g), A= absorbance (ARNON, 1949).

In case of assaying peroxidase (POD) enzyme activity, 3×150 mg leaf from every groups were homogenized in a refrigerated mortar with the use of 1.5 ml KH_2PO_4 (pH=6.5, 0.05 M). After centrifuging (4 °C, 20 minutes, 13500 rpm), separated extracts (without solid particles) were applied for spectrophotometric investigations (adjusted wavelength: 460 nm). For reaction, plant extracts (3 × 0.01 ml per group) were mixed with 1.7 ml $C_2H_3NaO_2$ (pH=4.5, 0.1 M), 0.03 ml H_2O_2 and 0.02 ml ortodianisidine (3.3'-dimethoxybenzidine) as chromogen reagent. Enzyme activity ($U\ mg^{-1}$) was calculated with formula ($\Delta A1 \times$ attenuation)/ε; where ΔA1 = absorbance change/1 min, ε = 11.3: extinction coefficient of ortodianisidine (SHANNON ET AL., 1966; BLINDA ET AL., 1996). Three repetitions from every treatment were used for examinations of all biochemical parameters.

Data and statistical analysis

Data were evaluated by Ropstat statistical software (VARGHA, 2008). An analysis of variance (ANOVA) was conducted to calculate the statistical significance of all data presented. When significant differences between treatments were found, the means were separated by Tukey's test at $p<0.1$, $p < 0.05$.

RESULTS

Leaf length and width

The use of 100% ASB soil resulted in the longest (190.17 mm) and widest (80.6 mm) leaves. In this (first) trial, significantly the shortest (133.34 mm) leaves were found on cuttings grown on perlite. In addition, significant differences were obtained if we compared results of the second and third trials (by the application of the same substrate

mixtures). In the latter case and because of the higher temperatures during growing time, plants developed considerably longer and wider leaves, especially on ASB soil + BRT Moss combination (185.91 mm length, 70.63 mm width). Mixing of perlite and BRT Moss eventuated the smallest leaves both in the second and third studies (*Figure 1*). In these cases, leaves were mostly shorter than 120 mm, narrower than 50 mm.

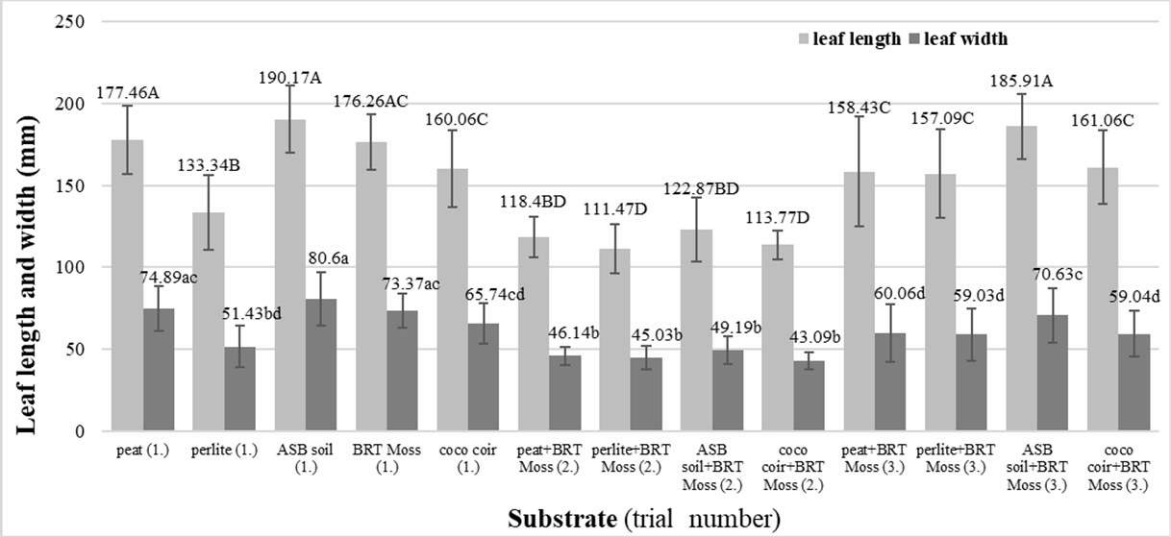

Figure 1. Leaf length and width of *Philodendron erubescens* cuttings. Means with different letter are significantly different by Tukey's test at p<0.1, p < 0.05

Length of shoots and roots

The longest (147.26 mm) shoots were grown when ASB soil + BRT Moss mixture was used in the third trial. In almost every groups, significantly smaller shoot lengths were achieved excepting the result of 100% BRT Moss in the first study (135.49 mm). This latter agent was the best when pure soils (without mixing) were applied. In another trial with the same *Philodendron*, also BRT Moss resulted the highest plants during acclimatization, the last stage of their micropropagation (ÖRDÖGH AND VIZER, 2018). Lower growing temperatures (during the second experiment) and in the first trial, 100% perlite resulted in the shortest shoots.

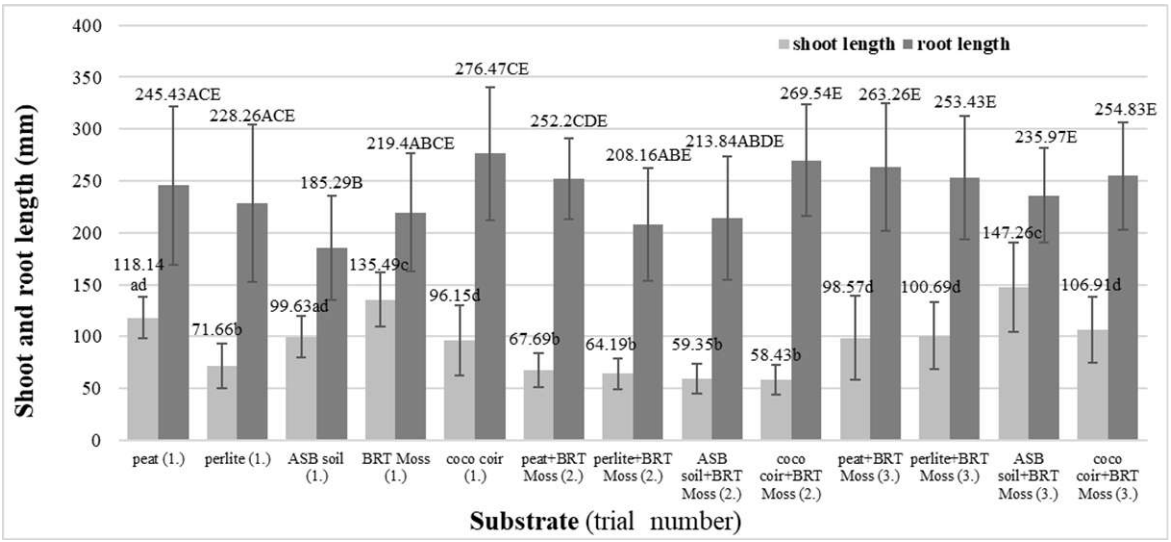

Figure 2. Shoot and root length of *Philodendron erubescens* cuttings. Means with different letters are significantly different by Tukey's test at p<0.1, p < 0.05

The use of 100% coco coir and in the second trial, 50-50% coco coir + BRT Moss resulted in the longest roots (276.47 and 269.54 mm). Significantly shorter roots were developed in 100% ASB soil (first study) or in mixtures containing ASB soil or perlite in the second and third experiments (*Figure 2*). Probably, excessively dense, heavy (ASB soil) or easily drying, light weight substrates (perlite) were not optimal for the root elongation of these plants.

Number of shoots and roots

For producing more (12.56 and 14.8) roots, 100% coco coir or even more 50-50% ASB soil+BRT Moss (in the third study) were the best and 100% perlite or ASB soil the worst. The latter substrate similarly resulted in the smallest root values (number, length) during acclimatization of *Philodendron erubescens* (ÖRDÖGH AND VIZER, 2018). The most shoots (2.88 and 2.77) were achieved in the second study, especially when peat or coco coir was combined with BRT Moss (*Figure 3*). On the other hand, greenhouse temperatures also influenced the shoot number: in this experiment, lower night temperatures during autumn and especially winter (6-12 °C) inhibited shoot tip growing, therefore, more new shoots emerged from the lateral buds of the middle or basal parts of the cuttings.

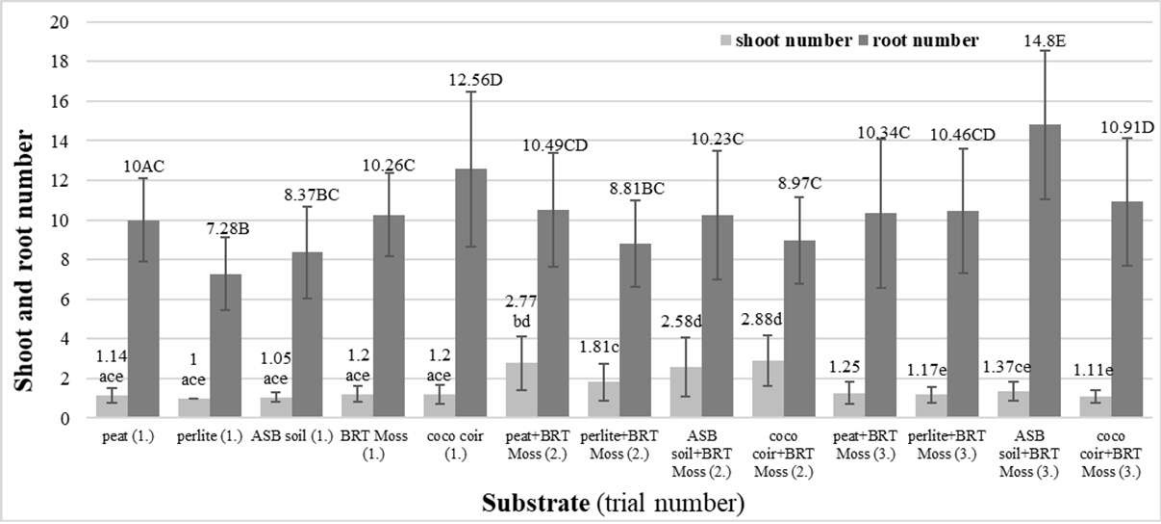

Figure 3. Shoot and root number of *Philodendron erubescens* cuttings. Means with different letter are significantly different by Tukey's test at p<0.1, p < 0.05

Fresh green and root weight

As we can see on *Figure 4*, fresh green (leaves + shoot) weight values were larger than fresh root weights only in the first and third trials when warmer temperature resulted in considerably larger leaves and longer shoots. The shoot number did not influence the fresh green weight because of the relatively small size of the lateral, newly developed shoots. Furthermore, in all three trials, significantly the lowest values were obtained in the case of applying perlite (100% in the first or 50% perlite + 50% BRT Moss in the other two study) and the largest when pure ASB soil, BRT Moss or as mixtures, ASB soil + BRT Moss, coco coir + BRT Moss were used. Worthy of note that usually there was a positive coherence between fresh green weight and leaf sizes, shoot length.

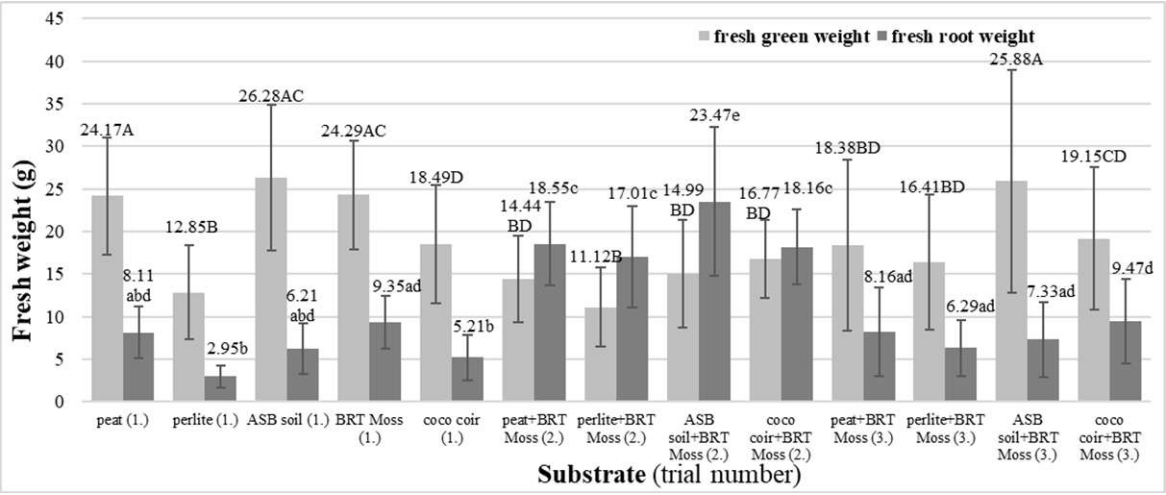

Figure 4. Fresh green and root weight of *Philodendron erubescens* cuttings. Means with different letter are significantly different by Tukey's test at p<0.1, p < 0.05

Total chlorophyll and carotenoid contents of leaves

In the third experiment, 50-50% combination of BRT Moss and ASB soil resulted in the highest values: 4749.7 µg g^{-1} total chlorophyll and 95.67 µg g^{-1}carotenoid. If only pure substrates were used, 100% BRT Moss eventuated maximal pigment contents (3550 µg g^{-1} and 75.23 µg g^{-1}). The latter soil also eventuated the highest chlorophyll level when plantlets of the same species were acclimatized (ÖRDÖGH AND VIZER, 2018).

Temperatures also influenced leaf pigment contents. Significantly higher (and if we compare with the other two trial: mostly the highest) values were acquired in the third study, due to the warmer, optimal (20-22 °C) temperatures during growing period. Therefore, the lowest chlorophyll and carotenoid contents were determined in the second study, when air temperature often decreased below 15 °C during especially winter (*Table 1*).

Table 1. Total chlorophyll and carotenoid content, peroxidase enzyme activity of leaves of *Philodendron erubescens* cuttings. Means with different letter are significantly different by Tukey's test at p<0.1, p < 0.05

Trial number	Substrate	Total chlorophyll content (µg g^{-1})	Carotenoid content (µg g^{-1})	Peroxidase activity (U mg^{-1})
1.	100% peat	2276.3 AC	50.1 ac	0.0009 *ace*
	100% perlite	3451.7 BD	73.3 bd	0.0007 *ace*
	100% ASB soil	3181 ABD	67.07 abd	0.0023 *bd*
	100% BRT Moss	3550 BD	75.23bd	0.0005 *ae*
	100% coco coir	2746.7 ABCD	60.33 abcd	0.0012 *acd*
2.	50-50% peat + BRT Moss	2086 AC	51.23 ac	0.0009 *acde*
	50-50% perlite + BRT Moss	2214 C	56 ac	0.0015 *cd*
	50-50% ASB soil + BRT Moss	2942.7 B	75.5 bd	0.0019 *d*
	50-50% coco coir + BRT Moss	1959.3 C	50.9 c	0.0018 *d*
3.	50-50% peat + BRT Moss	3499.7 BD	74.47 bd	0.0004 *e*
	50-50% perlite + BRT Moss	3760 D	80.47 d	0.0004 *e*
	50-50% ASB soil + BRT Moss	4749.7 E	95.67 e	0.0003 *e*
	50-50% coco coir + BRT Moss	3225 D	70.07 d	0.0003 *e*

Peroxidase enzyme activity (POD) of leaves

The least stressed plants (with the lowest POD values: 0.0003-0.0004 U mg^{-1}) were grown in the third trial at higher temperatures. The same substrate mixtures with unfavourably lower temperatures resulted in higher enzyme activity (0.0009-0.0018 U mg^{-1}) in the second study. If we compared the effects of different substrates, 100% ASB soil and 50-50% ASB soil + BRT Moss, coco coir + BRT Moss (in the second experiment) enhanced these values (*Table 1*).

CONCLUSIONS

The highest morphological and physiological values were obtained when BRT Moss, ASB soil or their combinations were used as substrate for cutting propagation. Additionally, coco coir (and its admixture with BRT Moss) had positive effect on development of roots and shoots, but for producing larger sized plants (with faster growing and shorter duration time) warmer temperatures (optimally 20-22 °C) are recommended, especially during cool autumn and winter seasons. Accordingly, bottom or basal heat is preferable for the sake of better, successful rooting. As cheaper options, we can use other substrates (for example vermiculite, gravel or sand) as further accessories of different soil mixtures containing applicable agents (like BRT Moss, coco coir etc.), but more test is necessary to find the best substrates.

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TRADE CHARACTERISTICS OF NEW MEMBER STATES' AGRICULTURE

TAMAS MIZIK

Corvinus University of Budapest, 1093 Budapest, Fővám tér 8.

tamas.mizik@uni-corvinus.hu

ABSTRACT
New member states (NMS) joined the European Union (EU) in 2004 or later. They became a part of the common, unified market. Without any trade restrictions, NMS were able to trade with every member state. On the other hand, generous support of the Common Agricultural Policy also boosted their agricultural sector. This paper gives an overview of the OMS' agricultural performance, followed by a detailed trade analysis. It identifies major export products and the concentration of trade. Agricultural trade will be separated into NMS and old member states (OMS) to reveal differences and similarities in the trade patterns.

Keywords: New Member States, agricultural production and trade, agricultural chapters

INTRODUCTION

New member states (NMS) joined the European Union (EU) in 2004 or later. They became a part of the common, unified market. It resulted in new market opportunities as well as new threats to the agricultural sector as well. It employs 8.55 million people in the EU, approximately half of them in the NMS (EUROSTAT, 2019). Agriculture contributes to the Gross Domestic Product and to the trade balance.

Compared to Poland, Hungary and Romania operated with a higher level of support, but they have not paid enough attention to measures aimed at enhancing competitiveness, unlike Poland (KIRSCHKE, 2009). In general, the EU accession had a positive impact on the agricultural productivity and trade performance of the new member states (CSÁKI AND JÁMBOR, 2009). However, farmers in the NMS had/have to compete with OMS farmers under a common policy framework (the Common Agricultural Policy).

MATERIAL AND METHOD

Basic agricultural indicators (contribution of agriculture to the GDP, agricultural employment and size of agricultural production) are based on World Bank's WDI and FAO database. Trade data (agricultural export and import, trade balance) is derived from the WTO database. The major data source of the paper is the World Bank's World Integrated Trade Solution (WITS) database at the HS-2 level between 2000 and 2017 on agricultural products (chapters 1-24). It covers almost four pre-accession years (or even more for Bulgaria, Romania and Croatia). The last year is the latest available one in the WITS database. List of the analyzed chapters from live animals (chapter 1) to tobacco and

manufactured tobacco substitutes (chapter 24) can be found in *Annex 1*. Due to the marginal share of agriculture, Cyprus and Malta are excluded from the analysis.

Based on the above-mentioned databases, mathematical and statistical calculations were made (shares, differences, etc.). Trade data was separated both on agricultural chapter and NMS member state level in order to reveal chapter and country-specific patterns. Extra- (outside the region) and intra-trade (within the region) were also analyzed. It should be noted that, for easier comparison, only intra-trade values are represented. For extra-trade values, this is calculated by 100% minus the percentage share of the intra-trade.

RESULTS

Agriculture is more important in the new member states than in the old ones measured either in sectoral value added or agricultural employment (*Table 1*). The EU averages were 1.4% and 4.3% respectively compared to the NMS averages of 3.02% and 7.59% (World Bank's WDI, 2019). Among the NMS, Romania has the most significant agricultural sector which employs almost one-fourth of the total workforce. Romania is followed by Poland (10.58%) and Lithuania (7.98%).

Table 1. Basic indicators of the NMS' agriculture, 2016

	Agricultural value added (% of GDP)	Agricultural employment	Agricultural production (million USD)
Bulgaria	4.05	6.75	3931
Croatia	3.14	7.60	1600
Czech Republic	2.06	2.90	4571
Estonia	2.09	3.89	678
Hungary	3.87	5.04	6350
Latvia	3.21	7.69	1040
Lithuania	3.08	7.98	2182
Poland	2.38	10.58	19870
Romania	4.06	23.10	14869
Slovak Republic	3.36	2.89	1911
Slovenia	1.88	5.02	888
Average	3.02	7.59	5263

Source: based on World Bank's WDI (2019) and FAO database (2019)

The contribution of agriculture to both the exports and imports varies between the countries (*Table 2*). On the exports side, there are even larger differences from 6.18% (Czech Republic) to 30.61% (Latvia). Except for Lithuania, this ratio is below 20% in the other countries. Regarding imports, again Latvia spends the most on agricultural products (18.63%) followed by Lithuania and Croatia. On the other side, Hungary (7.12%), the Slovak and the Czech Republic can be found (7.23% and 7.34%, respectively).

Table 2. Share of agriculture in the trade, 2000-2017

Countries	2000-2005		2006-2011		2012-2017	
	Exports	Imports	Exports	Imports	Exports	Imports
Bulgaria	12.72%	6.71%	14.56%	8.87%	17.60%	10.91%
Croatia	14.25%	10.01%	14.82%	10.43%	18.22%	13.85%
Czech Republic	5.58%	6.77%	5.41%	6.85%	6.18%	7.34%
Estonia	14.59%	10.68%	14.87%	12.63%	16.19%	13.17%
Hungary	8.02%	4.76%	8.06%	6.11%	9.68%	7.12%
Latvia	33.82%	14.31%	28.55%	15.91%	30.61%	18.63%
Lithuania	15.02%	10.65%	19.01%	13.11%	21.03%	15.44%
Poland	9.72%	7.90%	11.42%	8.78%	14.10%	10.33%
Romania	6.52%	7.94%	8.40%	8.66%	12.21%	10.70%
Slovak Republic	5.41%	6.86%	5.45%	7.11%	5.28%	7.23%
Slovenia	4.82%	9.17%	6.73%	10.67%	8.08%	11.56%

Source: Calculations based on WTO (2019) database

Based on the size of agricultural exports and imports, agricultural trade balance can be calculated. It can be seen in *figure 1* that 6 out of the 11 NMS has agricultural trade balance, most notably the size of the Polish surplus earns attention. Taking into consideration the fact that Poland was a net importer of the agricultural goods before the accession, it a success story of how to use the financial resources of the Common Agricultural Policy efficiently (MIZIK ed., 2019). However, even without Poland, the NMS are self-sufficient as they export more agricultural goods than import.

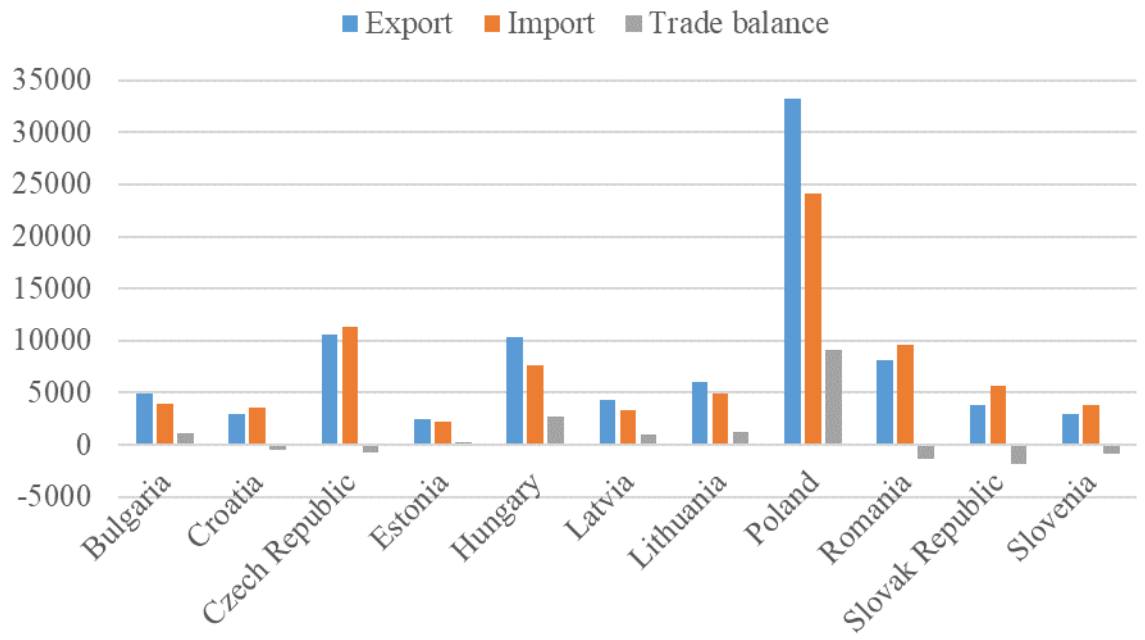

Figure 1. Agricultural trade of the NMS, 2017 (million current USD)

Source: Data is derived from WTO (2019) database

As the members of the single market, NMS are able to reach the Western markets as well. That is the reason why "regional" trade is on a relatively low level, it varies between 47.83% and 12.68% (*Table 3*). Mostly coffee and tea (chapter 9), animal or vegetable fats and oils (chapter 15) and live animals (chapter 1) are traded among the new member states. Except for the latter one, the two other chapters contain processed products. On the other side lac; gums, resins and other vegetable saps and extracts (chapter 13), cereals (chapter 10) and aquatic products (chapter 3) can be found. Compared to the other highlighted chapters, chapter 13 has an insignificant trade value. Overall, 26.76% of the total agricultural exports are traded within the NMS.

Table 3. Major characteristics of NMS' agricultural exports, 2017

HS codes	Total agricultural exports (million USD)	NMS' agricultural exports (million USD)	Share of NMS (%)
09	1328770	635537	47.83%
15	2569479	1061222	41.30%
01	1978736	773924	39.11%
11	1049784	410050	39.06%
17	2232750	834530	37.38%
22	4240728	1480756	34.92%
04	6124879	2061000	33.65%
23	3782565	1244903	32.91%
21	4535377	1413769	31.17%
08	2289652	692966	30.27%
14	12533	3723	29.71%
20	2590217	760361	29.36%
19	4629927	1347256	29.10%
16	3119607	883346	28.32%
18	3113574	848826	27.26%
07	2132512	556800	26.11%
02	7604599	1898986	24.97%
06	472596	91507	19.36%
12	4311248	778960	18.07%
05	539173	91899	17.04%
24	6334182	1048214	16.55%
03	2727409	381757	14.00%
10	8606055	1137115	13.21%
13	113753	14423	12.68%
Together	76440107	20451830	26.76%

Source: Calculations based on World Bank's WITS (2019) database

Taking a closer look at the agricultural trade, more details can be revealed (*Table 4*). The major grain producers (Poland and Romania) sell most of their cereals to other than NMS countries. It explains its low regional share. The high Croatian extra-trade of aquatic

products (85.31%) resulted in a low regional share (14.69%). High intra-trade shares can be found in the Czech and the Slovak Republic due to their tight, historical and geographical connection. It explains the relatively high Baltic shares as well. Basically, the list of the top least and most regionally traded products highly overlapped with the export structure of the most significant regional producer, as well as exporter, Poland. Due to its size, Poland is not able to sell its products on this relatively small market, which resulted in the lowest regional intra-trade shares.

Table 4. TOP3 shares of NMS' extra- and intra-trade, 2017 (%)

Countries	TOP3 extra-trade chapters			TOP3 intra-trade chapters		
Bulgaria	0.00 (14)	8.13 (24)	8.70 (10)	64.42 (9)	44.60 (18)	38.50 (22)
Croatia	10.78 (10)	11.42 (12)	14.69 (3)	92.38 (14)	51.81 (7)	51.77 (17)
Czech Republic	10.18 (13)	14.70 (24)	16.39 (10)	80.63 (16)	79.11 (7)	78.94 (8)
Estonia	0.53 (14)	1.32 (18)	2.87 (6)	62.27 (11)	60.45 (4)	53.99 (1)
Hungary	10.16 (24)	10.72 (5)	19.06 (12)	74.26 (11)	67.65 (9)	52.75 (6)
Latvia	8.88 (22)	9.24 (10)	11.42 (12)	87.48 (24)	85.32 (9)	81.91 (8)
Lithuania	1.48 (6)	4.41 (14)	9.95 (3)	84.30 (1)	65.84 (17)	65.63 (15)
Poland	3.19 (10)	4.72 (3)	9.33 (5)	43.33 (15)	28.47 (22)	26.83 (9)
Romania	4.75 (10)	5.65 (7)	6.19 (14)	66.70 (17)	47.05 (9)	46.95 (18)
Slovak Republic	23.14 (6)	37.85 (10)	49.21 (4)	99.42 (14)	97.96 (3)	93.75 (16)
Slovenia	4.16 (13)	5.92 (1)	6.74 (10)	71.95 (23)	71.17 (3)	65.24 (24)

Source: Calculations based on World Bank's WITS (2019) database

CONCLUSIONS

Based on the analysis above, the following conclusions can be made:

- Although it shows a decreasing trend, agriculture still plays a more important role in the NMS than in the OMS, especially in Romania.
- Agricultural export significantly contributes to foreign earnings, it gives more than 30% of the total export revenues in Latvia. The import side shows smaller differences, it varies between 18.63% (Latvia) and 7.12% (Hungary).
- 6 countries out of the analyzed 11 have a trade surplus and Poland is by far the greatest producer of the region. One of its major reason was the EU accession.
- Except for live animals, processed foods are traded between the NMS, while cereals are the most significant extra-traded commodities in terms of exports value.
- extra trade is high in Poland due to its high production and export capacity. Intra-trade is important among the Slovak and the Czech Republic, as well as in the Baltic countries due to some similar reasons like historic connection and geographical closeness.

ACKNOWLEDGEMENTS

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Annex 1. Description of the agricultural chapters

HS code	Product description
01	Live animals
02	Meat and edible meat offal
03	Fish and crustacean, mollusc and other aquatic invertebrates
04	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
05	Products of animal origin, not elsewhere specified or included
06	Live tree and other plants; bulb, roots and the like; cut flower and ornamental foliage

07	Edible vegetables and certain roots and tubers
08	Edible fruit and nuts; peel of citrus fruit or melons
09	Coffee, tea, maté and spices
10	Cereals
11	Products of the milling industry; malt; starches; inulin; wheat gluten
12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit, industrial or medicinal plants, straw and fodder
13	Lac; gums, resins and other vegetable saps and extracts
14	Vegetable plaiting materials; vegetable products not elsewhere specified or included
15	Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes
16	Preparation of meat, fish or crustaceans, molluscs or other aquatic invertebrates
17	Sugars and sugar confectionery
18	Cocoa and cocoa preparations
19	Preparation of cereal, flour, starch or milk; pastrycooks' products
20	Preparation of vegetables, fruit, nuts or other parts of plants
21	Miscellaneous edible preparations
22	Beverages, spirits and vinegar
23	Residues and waste from the food industries; prepared animal fodder
24	Tobacco and manufactured tobacco substitutes

Source: World Bank WITS database (2019)

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TRADE CHARACTERISTICS OF THE WESTERN BALKANS' AGRICULTURE

TAMAS MIZIK

Corvinus University of Budapest, 1093 Budapest, Fővám tér 8.

tamas.mizik@uni-corvinus.hu

ABSTRACT
Western Balkans countries can be characterized by their shared aim, the quickest possible accession to the European Union (EU), to their major trade partner. Autonomous trade preferences granted by the EU were renewed until 2020 and they provide free trade to these countries for most of their products. This paper gives an overview of the Western Balkans' agricultural performance, followed by a detailed trade analysis. It identifies major export products and the concentration of trade. Agricultural trade will be separated into regional and EU markets to reveal differences and similarities in the trade patterns.

Keywords: Western Balkans, agricultural production and trade, agricultural chapters

INTRODUCTION

Western Balkans countries can be characterized by their shared aim, the quickest possible accession to the European Union (EU), to their major trade partner. However, their status is different. Based on DE MUNTER (2018), Montenegro leads, 30 out of the 35 negotiating chapters has been opened by the end of 2017. Montenegro is followed by Serbia where negotiations have been started on 12 chapters. Albania and North Macedonia are official candidate countries, while Bosnia and Herzegovina and Kosovo are potential candidates. Montenegro and Serbia have a chance to join the EU by 2025, although it is a very ambitious aim from the European Commission (GRIEVESON et al., 2018). But even being outside the club, the EU is the most important trading partner of the region (MIZIK, 2016). However, it is a question of whether there are regional differences between these countries.

MATERIAL AND METHOD

Basic agricultural indicators (contribution of agriculture to the GDP, agricultural employment and size of agricultural production) are based on World Bank's WDI and FAO database. Size of agricultural production is measured in million constant 2004-2006 international dollar. It is a theoretical currency used by the FAO, World Bank, IMF or UN. It combines the exchange rate, purchasing power parity and international average prices of commodities. It shows the purchasing power that the US dollar had in the United States at the given year. Therefore, it is better for comparisons, but cannot be directly converted into other currencies simply using the exchange rates.

Trade data (agricultural export and import, trade balance) is derived from the WTO database. The major data source of the paper is the World Bank's World Integrated Trade Solution (WITS) at HS-2 level between 2006 and 2017 on agricultural products (chapters 1-24). The first year is in accordance with the end of the state union of Serbia and Montenegro after Montenegrin voters voted for independence. The last year is the latest available year in the WITS database. List of the analyzed chapters from live animals

(chapter 1) to tobacco and manufactured tobacco substitutes (chapter 24) can be found in *Annex 1*.

Based on the above-mentioned databases, mathematical and statistical calculations were made (shares, differences, etc.). Trade data was separated both on agricultural chapter and Western Balkan's country level in order to reveal chapter and country-specific trade patterns. Extra- (outside the region) and intra-trade (within the region) were also analyzed. It should be noted that, for easier comparison, only intra-trade values are represented. For extra-trade values, this is calculated by 100% minus the percentage share of the intra-trade.

RESULTS

Based on the basic agricultural indicators, agriculture plays the most important role in Albania. It gives almost 20% of total value added and employs 40% of the total workforce (*Figure 1*). However, all the other countries' results are higher than even the new member states' averages, especially the agricultural value added. In the same year, it was only 3.14% in Croatia or 3.87% in Hungary (World Bank's WDI, 2019). What is obvious from the figure below that Serbia is the most significant producer of the region, producing more than the four other countries together. Montenegro has the smallest agricultural sector in line the smallest physical size of the country.

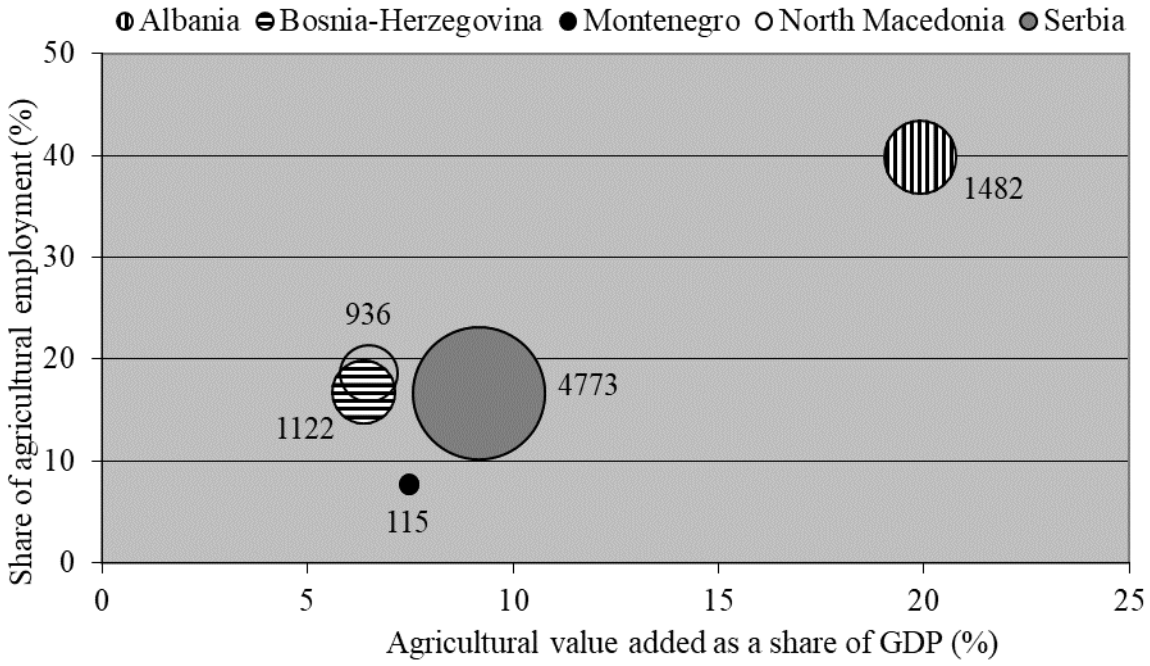

Figure 1. Basic indicators of the Western Balkan countries' agriculture, 2016 based on World Bank's WDI (2019) and FAO database (2019)

The importance of agriculture can be measured on its importance in international export and import. *Table 1* summarizes these data by using four-year averages. Except for North Macedonia, all the other countries show increasing trend both on exports and, surprisingly, imports side. Although Montenegro has the smallest agricultural production in the region,

it depends on its export revenues the most. Its value was more than one-fourth of the total exports revenues. Montenegro is followed by Serbia, Bosnia and Herzegovina, North Macedonia and Albania. The latter one is striking as Albanian agriculture is the largest one in terms of sectoral value added or employment. As a matter of imports, again Montenegro can be found in the first place, while Serbia is the last.

Table 1. Share of agriculture in the trade, 2006-2017, based on WTO (2019) database

Countries	2006-2009		2010-2013		2004-2017	
	Exports	Imports	Exports	Imports	Exports	Imports
Albania	8.70%	17.87%	6.93%	18.55%	9.94%	17.93%
Bosnia and Herzegovina	13.49%	18.04%	13.65%	19.51%	15.09%	18.85%
Montenegro	15.02%	18.33%	20.17%	25.06%	27.62%	25.06%
North Macedonia	15.63%	12.87%	15.68%	13.42%	12.06%	12.15%
Serbia	21.37%	7.39%	22.95%	8.58%	21.44%	9.27%

Based on agricultural exports and imports data, agricultural trade balance can be calculated (*Figure 2*).

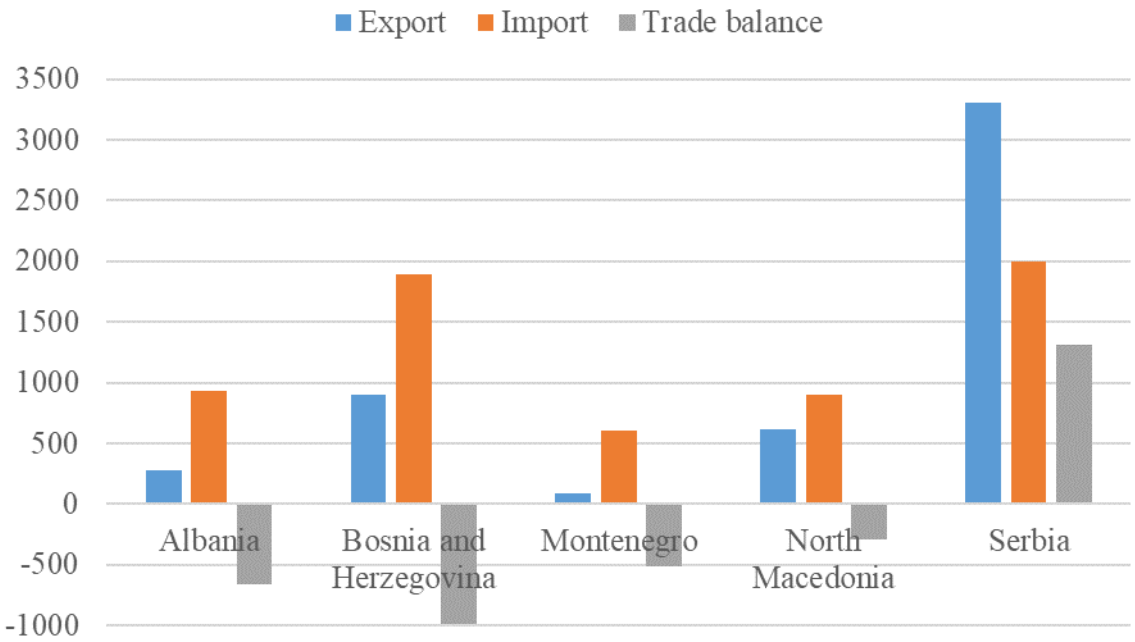

Figure 2. Agricultural trade of the Western Balkan countries, 2017 (million current USD). Data is derived from WTO (2019) database

Only Serbia has a trade surplus in the region, all the other countries have agricultural trade deficit resulting in a net importer (1.1 billion USD) position on the regional level. Taking a closer look at the agricultural export, more conclusions could be drawn. *Table 2* shows the

agricultural exports chapters in decreasing order of the share of regional trade (within the Western Balkans).

Table 2. Major characteristics of Western Balkans' agricultural exports, 2017

HS codes	Total agricultural exports (million USD)	WB' agricultural exports (million USD)	Share of WB (%)
1	60736	53040	87.33%
18	87925	60673	69.01%
4	132036	76725	58.11%
22	345576	190221	55.04%
16	160181	82734	51.65%
19	258943	127083	49.08%
11	114939	54616	47.52%
21	210811	98803	46.87%
2	114871	53299	46.40%
15	303216	116968	38.58%
17	151974	57732	37.99%
23	191543	60303	31.48%
13	2421	751	31.03%
3	37257	10499	28.18%
20	189474	53006	27.98%
7	259077	72354	27.93%
10	406547	110983	27.30%
9	29064	7253	24.96%
12	188506	42834	22.72%
24	460515	59384	12.90%
6	36759	4506	12.26%
14	1062	104	9.76%
8	821350	65935	8.03%
5	8049	633	7.86%
Together	4572833	1460438	31.94%

Source: Calculations based on World Bank's WITS (2019) database

Not surprisingly the share of regional trade is the highest for the live animals (chapter 1) as they cannot be transported to far distance (chapter 18 and 4, respectively). It is followed by cocoa and cocoa preparations and dairy produce; birds' eggs; natural honey. The least regionally traded products are products of animal origin, edible fruit and nuts and vegetable plaiting materials (chapter 5, 8 and 14, respectively). The first one is a processed product which can be transported. The two other product groups are exported mostly to the EU markets as the EU is not self-sufficient.

The country-level analysis gives more information on the trade patterns (*Table 3*). Results reflect on the dominant Serbian position as all the three least traded product and two of the three most traded products are the same as the TOP3 least and most traded products in table 2. The only exception is the preparation of meat, fish or crustaceans, molluscs or

other aquatic invertebrates (chapter 16). Its reason is simple: Albania sells most of these products outside the region, only 0.24% sold in the other Western Balkan countries. Serbia has generally lower intra-trade values as the higher part of its production could not be marketed in the neighbouring countries.

Table 3. TOP3 shares of Western Balkans' extra- and intra-trade, 2017 (%)

Countries	TOP3 extra-trade chapters			TOP3 intra-trade chapters		
Albania	0.24 (16)	0.43 (5)	1.09 (1)	100.00 (10)	97.37 (17)	83.67 (15)
Bosnia and Herzegovina	2.17 (15)	5.73 (9)	7.97 (10)	84.69 (16)	78.18 (18)	75.19 (4)
Montenegro	4.89 (19)	6.20 (12)	7.43 (9)	99.99 (11)	98.40 (23)	98.05 (3)
North Macedonia	0.32 (5)	0.61 (6)	5.87 (24)	100.00 (14)	99.97 (16)	99.87 (13)
Serbia	1.86 (8)	10.42 (5)	10.54 (14)	90.98 (1)	73.47 (16)	70.18 (18)

Source: Calculations based on World Bank's WITS (2019) database

CONCLUSIONS

Based on the analyzed data, the following conclusions can be drawn:

- Agriculture still plays an important role in the region measured by either GDP contribution or employment, especially in Albania.
- Share of agricultural exports within total exports is generally higher than the share of agricultural imports within total imports.
- Except for Serbia, all the other Western Balkan countries are net importers of agricultural goods.
- Regional effects can be seen on the chapter level, however, it varies between 87 and 8%.
- Serbia, the largest producer and exporter, has more diversified trade connections resulting in lower intra-trade values.

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Annex 1. Description of the agricultural chapters

HS code	Product description
01	Live animals
02	Meat and edible meat offal
03	Fish and crustacean, mollusc and other aquatic invertebrates
04	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
05	Products of animal origin, not elsewhere specified or included
06	Live tree and other plants; bulb, roots and the like; cut flower and ornamental foliage
07	Edible vegetables and certain roots and tubers
08	Edible fruit and nuts; peel of citrus fruit or melons
09	Coffee, tea, maté and spices
10	Cereals
11	Products of the milling industry; malt; starches; inulin; wheat gluten
12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit, industrial or medicinal plants, straw and fodder
13	Lac; gums, resins and other vegetable saps and extracts
14	Vegetable plaiting materials; vegetable products not elsewhere specified or included
15	Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes
16	Preparation of meat, fish or crustaceans, molluscs or other aquatic invertebrates
17	Sugars and sugar confectionery
18	Cocoa and cocoa preparations
19	Preparation of cereal, flour, starch or milk; pastrycooks' products

20	Preparation of vegetables, fruit, nuts or other parts of plants
21	Miscellaneous edible preparations
22	Beverages, spirits and vinegar
23	Residues and waste from the food industries; prepared animal fodder
24	Tobacco and manufactured tobacco substitutes

Source: World Bank WITS database (2019)

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DEVELOPMENT OF HIGH PROTEIN CONTAINING BAKERY FILLING

ADRIENN TÓTH[1], CSABA NÉMETH[2], TAMÁS CSURKA[1], JÓZSEF SURÁNYI[1], KATALIN BADAK-KERTI[1], PÉTER PENKSZA[2], LÁSZLÓ FRIEDRICH[1]

[1]Szent István University, Department of Refrigeration and Livestock Product's Technologies,

Budapest 1118, Ménesi út 43-45.

[2]Capriovus Ltd.

2317 Szigetcsép, Dunasor 073/72 hrsz.

toth.adrienn@etk.szie.hu

ABSTRACT

Development of nutrient-dense foods is one of the most important goals of today's food industry. High protein content of foods helps to provide energy and aminoacids for human body.

In our study protein enriched filling was developed for doughnuts. The main ingredients of the product were pudding powder and egg white product (TOTu, ToTu milk, ToTu cream, and ToTu cream extra).

The texture of samples was analyzed by Anton Paar Mcr 92 rheometer and the quality of products was evaluated by sensorial tests. Microbiological decontamination of HHP was investigated (500 MPa, 5 min).

Our results show that high protein content did not influence the sensorial quality of filling, as long the microbiota of the products is highly improved by HHP treatment. Rheological properties is highly influenced by the concentration of egg proteins.

The overall quality will be better, if egg white products are used for the product.

Keywords: High protein food, egg products, bakery products

INTRODUCTION

Egg white is a key ingredient in many food products as it combines high nutritional quality (SEUSS-BAUM, NAU, AND GUÉRIN-DUBIARD 2011) with excellent functional properties (de Souza and Fernández 2013). Lactase deficiency may lead to gastrointestinal symptoms after milk ingestion, known as lactose intolerance. Studies showed that lactose intolerant individuals avoid milk consumption, but they eat other dairy (PAWŁOWSKA ET AL. 2016). Lactose intolerance is a pathophysiological situation that occurs due to insufficiency of the "lactase" enzyme present in the jejunum. Ingestion of lactose containing products leads to alteration in intestinal digestion and colonic fermentation, leading to diarrhoea and other clinical discomforts (SURI ET AL. 2019).

The high content of essential amino acids in egg white proteins and the high bioavailability of these proteins are of great benefit to human nutrition. However, the effects of industrial processing such as dry heating on the nutritional quality of egg white proteins have been poorly documented. Some studies considered the effect of dry heating on the in vitro digestibility of proteins as it is a prerequisite to nutritional quality (SCHMIDT ET AL. 2007), but the effects of minimal processing technologies are not investigated in case of egg white. Studies are viable about the digestibility assays confirmed previous findings that exposure of egg white to high temperatures increased digestibility markedly. However, it seems that the effects of pH and salt concentrations were found to be minimal (LASSÉ ET AL. 2015).

In the egg product industry, microbiological safety of liquid products is mainly guaranteed by pasteurisation. The USDA requires that liquid whole egg is at least heated at 60 °C for no less than 3.5 min, but in the United Kingdom the recommendations are to pasteurize at least at 64 °C for 2.5 min (ROSSI ET AL. 2010). In France, there is no statutory heat

treatment; only microbiological results are determined by regulations. To achieve this, the treatments classically used to pasteurize whole egg vary from 65 to 68 °C for 2–5 min in order to ensure 5 to 6 decimal reductions of vegetative microorganisms and especially *Salmonella Enteritidis* and *Listeria monocytogenes* (BARON, JAN, AND JEANTET 2010). Pasteurisation temperatures used in the egg industry are limited by the sensitivity of egg proteins to heat treatment. Thus, pasteurisation for 2–10 min from 60 to 68 °C modifies whole egg electrophoretic pattern by especially decreasing ovotransferrin, livetin, ovalbumin, apovitellenin, lysozyme and/or ovomucin band intensity (BARTLETT & HAWKE 1995; ROSSI ET AL. 2010; LECHEVALIER ET AL. 2017).
Liquid egg white (LEW) and egg white-based products are usually regarded as functional foods for their excellent source of high-quality proteins, trace minerals, and for the ability of their components to coagulate, and to form foams when whipped. E.g. egg white proteins play important role in foam formulation of cake batters, like sponge cake (ALAVI ET AL. 2020). High Hydrostatic Pressure (HHP) is one of the most promising minimal processing technologies in the food industry, but only a few scientific studies are existing about HHP treatment and its effects on egg products (TÓTH ET AL. 2017).
On the other hand, egg white products are free from gluten, lactose and containing almost zero carbohydrates, these characteristics led to an increasing market of consumers, like people living on a paleolite, or low carb diet, or living with an allergic disease, or sensitivity against lactose, milk protein or gluten.
The goal of our experiment is to develop a special vanilla taste filling from egg white products, which has an increased protein content.

MATERIAL AND METHOD

Sample preparing

Material used for the development

Cortina

Cortina is a special pudding in powdered form which is used in pastry industry and has excellent sensorial quality. It contains sugar, modified starch, flavours and colour additives. The major advantages of Cortina are the fast and cold solubility and an excellent viscosity during filling procedure. Concentration of Cortina is usually 0,300 – 0,470 kg/L water, depending on desired texture.
Nutritional labelling is summarized in Table 1. containing the different concentrations of Cortina saluted in water.

Table 1: Nutritional labelling of Cortina, with the different concentrations of Cortina soluted in water

Nutrients	dimension	in dry Cortina	0.300 kg/ 1 L water dissolved	0.400 kg/ 1 L water dissolved	0.470 kg/ 1 L water dissolved
energy	KJ/100 g	1662	383.5	474.9	531.4
	Kcal/100 g	392.2	90.5	112.1	125.4
fat	g/100 g	4	0.9	1.1	1.3
unsaturated fatty acids	g/100 g	3	0.7	0.9	1.0
carbohydrates	g/100 g	85	19.6	24.3	27.2
sugar	g/100 g	60	13.8	17.1	19.2
dietary fiber	g/100 g	<0.1	<0.1	<0.1	<0.1
protein	g/100 g	4	0.9	1.1	1.3

Salt	g/100 g	1.4	0.3	0.4	0.4
Water	g/100 g	4	0.9	1.1	1.3
trans-fatty acids:	g/100 g	<0.1	<0.1	<0.1	<0.1
bred unit:	BE/100 g	7.1	1.6	2	2.3

ToTu products

ToTu products are made from egg white due to an enzymatic reaction. They contain only egg white. The different ToTu products have different textures and taste. The original goal of the ToTu products was to offer a lactose- and milk protein-free dairy analogue for people living with allergic reactions against milk ingredients.

- ToTu is a cottage-cheese analogue. The texture is cloddish, similar to traditional Hungarian cottage cheese. ToTu is rich in protein but has lower energy content compared with cottage cheese.
- ToTu cream is has a texture similar to sauercream. The texture is spoonable, viscosity of ToTu cream is higher compared with fermented dairy products (like yogurt, kefir).
- ToTu cream extra has a texture like buttercream, or cheese cream. The product is spreadable.
- ToTu milk is liquid as cow milk. The sensorial attributes are similar to normal milk. Techno functional and sensorial properties like viscosity are similar to normal or lactose-free milk.

Protein enrichment of pastry fillings

Pilot experiments (surveys and focus groups) pointed out, that the most important attributes of foods are sensorial characteristics, like taste and odor for Hungarian consumers. This point of view led us to develop the fillings according to sensorial tests.

First texture and taste were examined with a sensorial panel. Two different fillings were chosen for the next step of examination. The ingredients of the two types of fillings were:

- 150 mL ToTu milk, 45 g Cortina powder and 0,1 m/m vanilla flavour (powder)
- 100 mL ToTu milk, 40 g Cortina (powder), 20 g ToTu cream (creamy consistency) and 0,1 m/m vanilla flavour (powder)

12 panellists were taking part in the experiment they had to evaluate the samples between 1 and 5. The best evaluation was 5. Examined attributes were colour, spoonability, door, out flavour, texture, taste (overall), vanilla flavour, sweet taste, out-taste, overall quality. Finally they had to make a ranking of two developed and original (without any ToTu product) samples.

Rheological methods

Rheological properties determine the technological steps in a food processing. Rheological properties were measured with an Anton Paar MCR 92 rheometer. The method was an amplitude sweeping between 0 and 100%. From every samples G' and G" curves were measured, and yield point and flow point were calculated. *Figure 1.* demonstrates the different values measured and calculated by using the method. Knowing these data technological steps and characteristic can be concluded.

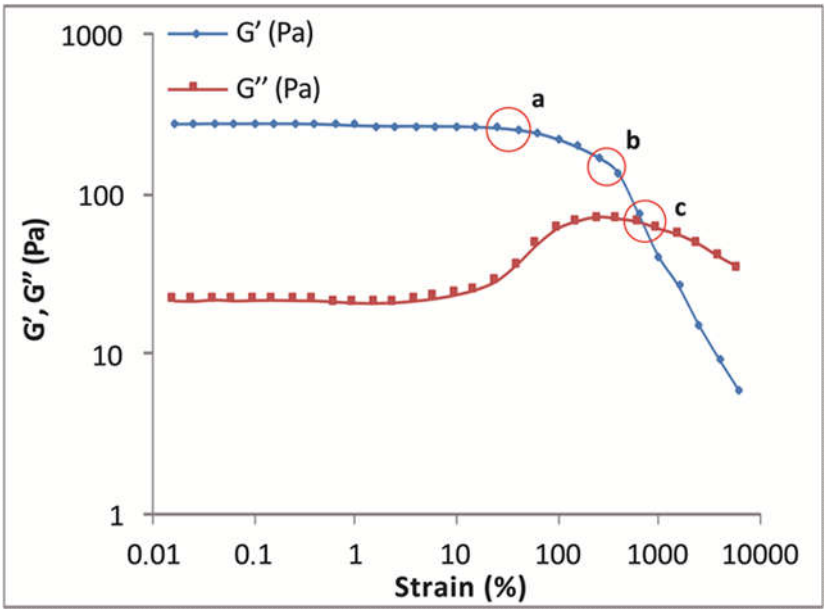

Figure 1: Parameters of amplitude sweeps method

RESULTS

Table 2 summarizes the nutritional labelling of developed fillings comparing with ToTu milk and with Cortina. The results highlight that protein content of pastry fillings were higly increased by adding ToTu products.

Table 2: Nutritional labelling of ToTu milk, Cortina soluted in water, and Cortina soluted in ToTu milk

Nutrients	Dimension	Sample in ToTu milk soluted with Totu milk	Sample in ToTu milk soluted	0,300 kg/ in 1 L water soluted
energy	KJ/100 g	383.5	97	458.2
	Kcal/100 g	90.5	23	108.2
fat	g/100 g	0.9	0	0.9
unsaturated fatty acids	g/100 g	0.7	0	0.7
carbohydrates	g/100 g	19.6	0.1	19.7
sugar	g/100 g	13.8	0.1	13.9
dietary fiber	g/100 g	<0.1	<0.1	<0.1
protein	g/100 g	0.9	5.6	5.2
Salt	g/100 g	0.3	0.1	0.3
Water	g/100 g	0.9		
trans-fatty acids:	g/100 g	<0.1	<0.1	<0.1
bred unit:	BE/100 g	1.6		2.1

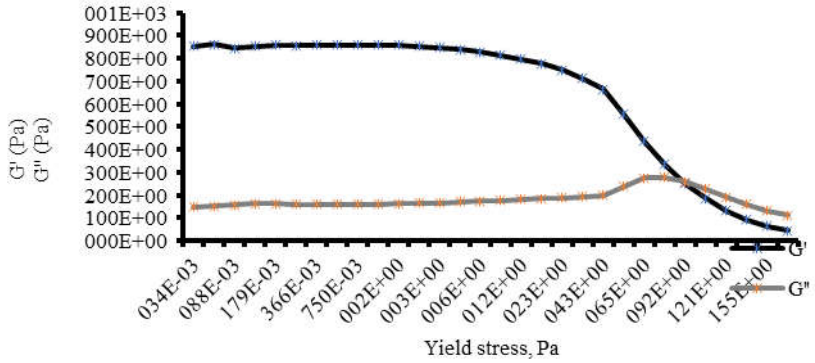

Figure 2: Rheogram of Cortina (300 g /L)

Figure 2. shows the rheogram of filling made with Cortina, compairing with Figure 10 and 11has to be considered, that G' increased by adding ToTu cream and milk, mut the highest impact has ToTu milk on G'. In contrast, G" slightly decreased by adding ToTu products.

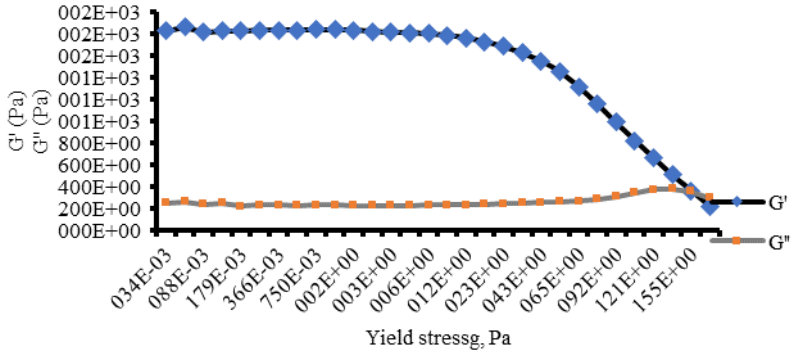

Figure 3: Rheogram of developed filling made with ToTu cream and ToTu milk

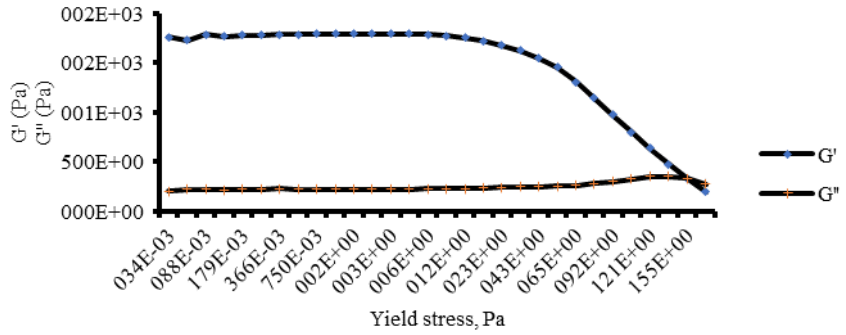

Figure 4: Rheogram of developed filling made with ToTu milk

Rheological properties of developed fillings are summarized in Figure 12. The best sensorial evaluation was fitted to the developed filling with ToTu milk, as long as this sample was the first in ranking of the three different evaluated samples.

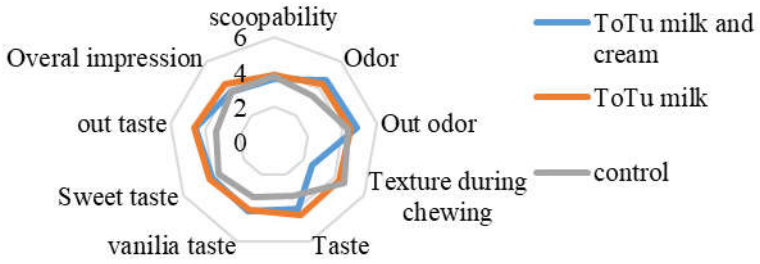

Figure 5: Results of sensorial tests

CONCLUSIONS

The protein-rich foods are getting today a more and more important role in special diets. In our experiment a protein enriched filling for different bakery and confectionery industry products, especially doughnuts were developed. According to our results, the techno-functional properties of the new products are similar, to the original, as long sensorial attributes are equal to original and in nutritional aspects the new, developed filling are better.

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EFFECT OF MANNANOLIGOSACCHARIDE (MOS) AND INULINSUPPLEMENTATIONONTHE PERFORMANCE OF CALVES REARED ON MILK REPLACER

SZANDRA TÓTH

University of Kaposvár, Faculty of Agricultural and Enviromental 7400 Kaposvár

tothszandra8@gmail.com

ABSTRACT
The objective of the current study was to examine the effects of mannan-oligosaccharides or inulin on HF dairy heifers' starter feed intake and daily weight gain in farm situations. We measured these parameters across two experiments. In Trial 1 (T1), next to the control group, 15-15 HF heifers received MOS or inulin supplementation from 1st day of age to weaning. The amount of the supplementations changed according the calves' age and the amount of milk replacer from 12 g to 24 g/calf/day. We measured the individual feed intake daily, the live weight at 0, 14, 21 and 60 days. In the second experiment (T2) we used 30 HF heifers also in three group (Control, MOS, Inulin) but we gave more from the experiment materials (28 g/calf/day MOS or Inulin). We started dosing the supplements with the colostrums feeding, and gave up on 14th day of age. We also measured the individual feed intake daily and the live body weight (BW) at 0, 14, 28, 42 and 56 days. The treatments in T1 did not cause significant differences in average feed intake, body weight and average daily weight gain. When the calves got the supplementation with colostrum too, the ADWG was significant lower in the group fed inulin than control and group fed MOS ($P<0.05$). We calculate the ADWG all of the experimental periods. From 0 to 14 day, and from 0 to 56 day the ADWG in inulin group was lower than control group, but the datas of group MOS did not differ from the others. Due to the distribution of the birth weights, the lower ADWG did not manifest in differences in body weight in other points of the experiments. We did not find an interaction between the treatments and the daily feed intake of calves. According with our measurements, the colostrum supplemented with inulin can be able to reduce ADWG while not affecting to the appetite.

Keywords: Mannanoligosaccharide, Inulin, dairy calves, Feed intake, Daily weight gain

INTRODUCTION

The use of antibiotics for growth promotion purposes, increases the risk of development of antibiotic-resistant bacterial strains and the appearance of drug residues in foods (SILVA ET AL. 2012). According to FRANKLIN ET AL. (2005), there is a need for alternative products that can ensure production, health protection and economic efficiency similar to that provided by antibiotics. Promotion of the performance of farm animals is based on optimal functioning of the digestive system, in which eubiosis of the gastrointestinal tract plays an important role. Prebiotics can be a solution to prevent digestive tract diseases and thereby improve animal performance. Of the dietary fibres, fructan (a polymer of fructose molecules) supports the growth of beneficial bacteria in the intestine. The best known fructan is inulin, which is naturally present in more than 36,000 plant species. MASANETZ ET AL. (2010, 2011) found that 2% inulin supplementation increased the average daily weight gain (ADWG) and slightly improved the feed conversion ratio, while KRÓL's (2011) research suggests that 3-6 g of inulin supplementation does not cause any change in feed intake and weight gain.

Mannanoligosaccharide (MOS) is a glucomannan–protein complex derived from the cell wall of yeast (*Saccharomyces cerevisiae*), which resists the action of digestive enzymes.MOS has excellent bacterium-binding properties. Supplementation of different doses of MOS (1 to 10 g/d) was reported to result in significantly increased feed intake (HEINRICHS et al. 2003, $P<0.05$; MORRISON et al. 2010, $P<0.01$; GHOSH AND MEHLA. 2012 $P<0.01$).GHOSH and MEHLA. (2012) and KRÓL (2011) observed a statistically significant

increase in BWG.

The objective of the current study was to compare the effect of different supply and amount of MOS or inulin on starter feed intake and body weight gain in real farm situation.

MATERIAL AND METHOD

A total of 75 HF calves (birth weight: 38.7 ± 3.67 kg) were included in the study within 2 trails. In every trial the heifers were divide into 3 equal groups (control, MOS, inulin) at time of birth (45 heifer in Trial 1 and 30 heifer in Trial 2). The calves received colostrum via an oesophageal tube within 2 h of birth only one time. The calves were took to individual hutches (Calf-Tel Pro II, Hampel Corporation, Germantown, Wisconsin, USA) after 12 to 24 h of birth. The calves had access ad libitum to fresh water from day 1 and calf starters (UBM Feed Ltd., Hungary) from 7th days.In Trial 1, in the experimental groups (MOS, inulin) got the supplements into the liquid feed from day 1 until we stopped the liquid feeding. While in Trial 2, the calves got the supplementation with the colostrums and with the liquid feed until d 14. The liquid feeding protocols and the amount of the supplements are shown in *Table 1*. In T1 the consumed milk replacer contain 21 % crude protein and 17,5 % fat level and were used with 14,5% dilution ratio, while in T2 we used another milk replacer with 27 % crude protein and 17 % fat level with 14 % dilution ratio.

Tables 1. Liquid feeding schedule and the amounts of the additives.

T1			T2		
day	liter/ day	amount of supplement g/day	day	liter/ day	amount of supplement g/day
0 day, colostrum	3	0	0 day, colostrum	4	28
1-14	5	12	1-4	6	28
15-21	7	12	4-14	8	28
22-49	9	24	15-49	8	0
50-56	4	12	50-53	6	0
			54-56	4	0

Individual starter feed intake was recorded daily for all animals. The calves were weighed at the time of their birth and then on d 14 and 60 in Trial 1, and on d 14, 56 in Trial 2. From these body weight data we calculated the individual body weight gains for the given periods. Statistical analysis was done using the R Commander 3.4.1 program type (Free Software Foundation Inc, 1991). Arithmetic means, standard deviation (SD) were calculated using descriptive statistical procedures. One-Way ANOVA procedures of the programme were use for analysing and compare the variances of feed intake on average weekly consumption. Differences were considered as significant if $P<0.05$. The recorded data on BW, ADWG variables were analysed using Repeated Measures Analysis of Variation and Tukey-Kramer multiple comparisons test were used to compare the differences between the results and to evaluate the significances of means between the different treatment groups of calves.

RESULTS

To compare the starter feed intake, we calculated an average weekly consumption in each group. These datas summarised in *Table 2*. Contrary to preliminary studies, none of the prebiotics in our study increased the starter feed consumption.

Table 2. Average starter diet intake of calves at different ages (g/day), mean ± SD

	T1			T2		
Age (days)	Control	MOS	Inulin	Control	MOS	Inulin
8-14	53±19	40±12	54±15	33±23	25±21	36±33
15-21	101±40	69±30	70±19	150±81	131±55	164±103
22-28	98±26	78±21	92±20	299±126	338±157	334±154
29-35	147±20	144±25	126±20	510±153	516±233	484±314
36-42	190±17	140±38	180±25	846±224	899±263	700±295
43-49	227±55	251±49	250±54	1138±297	1178±334	1024±277
50-56	754±368	603±286	660±329	1697±417	1842±327	1404±431
57-63	1818±548	1690±35	1790±421	2726±366	2813±282	2448±355

Contrary to the literature (GOSH AND MEHLA, 2012; KRÓL 2011) we did not find statistically significant differences between the control and the MOS supplemented groups in BW and ADWG either. MASANETZ ET AL. (2010, 2011) reports on the increase in ADWG, caused by MOS, but this statement are not supported by our data in T1 and T2 neither. 28 g inulin given with colostrum can modify negatively the ADWG (*Table 3*.). This statement contradicts with previous studies in literature because none of the studies which examined the inulin effects on calves report about negative effects (MASANETZ ET AL. 2010, 2011; KRÓL, 2011). In pigs fed with 3% inulin, BRAMBILLASCA ET AL. (2015) reported deterioration in feed efficiency and N retention. In T2, the measurements affected by inulin supplementation statistically differ from control group ($P<0.05$), and it slightly differ from MOS supplemented group too ($P<0.1$). Due to the distribution of the birth weights, the lower ADWG did not manifest in differences in body weight in other points of the experiments. Although, the Repeated Measures Analysis of Variation test shown that the BW and ADWG changes with time are statistically differ in groups ($P<0.01$) in T2.

Table 3. Body weight (kg) and averagedailyweightgain (g/day) ingroups (mean± SD)

age of weighing (day)	T1			T2		
BW	Control	MOS	Inulin	Control	MOS	Inulin
0.	39.5 ± 4.2	39 ± 2.7	38.8 ± 3.9	36.22±4.32	39.00±3.4	39.11±3.26
14.	44.9 ± 3.4	43.6 ± 4.4	43.5 ± 2.7	42.11±5.47	42.8±6.30	41.11±3.79
56.				79.56±8.53	81.9±6.36	75.56±6.60
60.	77 ± 8.6	77.4 ± 7.1	75.6± 3.72			
ADWG	Control	MOS	Inulin	Control	MOS	Inulin
0-14	380 ± 200	320 ± 210	320 ± 210	421±297[a]	383±193[ab]	140±198[b]
0-56				776±129[a]	761±69 [ab]	647±106 [b]
0-60	620 ± 110	630 ± 120	600 ± 80			

Different letters indicate significant difference between groups. a,b ($P<0.05$)

CONCLUSIONS

According to our studies, neither MOS nor inulin increases the starter feed intake for calves, regardless of the stage of calf rearing. 24 and 28 g/day MOS supplementation do not modify the body weight and average daily weight gain of calves. This finding is also true for 24 g non-colostrum inulin supplementation. 28 g inulin can decrease the ADWG if it given to the calves with the colostrum. As this amount (28 g) of inulin exceeds the amounts studied in the literature studies, it is possible that inulin has an upper limit for its applicability at an early age in dairy calves. Further studies are needed to discuss this position.

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IMPACT OF NUTRIENT LEVEL AND SEED DENSITY ON THE YIELD OF SOME WINTER WHEAT VARIETIES

ISTVÁN KRISTÓ[1], KATALIN IRMES[1], PÉTER JAKAB[2], MELINDA TAR[1]

[1] National Agricultural Research and Innovation Centre, Department of Field Crops Research, Alsó Kikötő sor 9., H-6726 Szeged, Hungary
[2] University of Szeged Faculty of Agriculture, Andrássy str. 15., H-6800 Hódmezővásárhely, Hungary
kristo.istvan@noko.naik.hu

ABSTRACT
The effects of four different nutrient levels (60 kg ha^{-1} N, 0 kg ha^{-1} P_2O_5, 0 kg ha^{-1} K_2O; 90 kg ha^{-1} N, 30 kg ha^{-1} P_2O_5, 30 kg ha^{-1} K_2O; 120 kg ha^{-1} N, 60 kg ha^{-1} P_2O_5, 60 kg ha^{-1} K_2O; 150 kg ha^{-1} N, 60 kg ha^{-1} P_2O_5, 60 kg ha^{-1} K_2O), as well as three different seeding rates (300, 500 and 700 seeds m^{-2}) on different winter wheat breeds have been investigated in this publication. The research was established in one growing season (2017/2018), with 5 winter wheat varieties (GK Arató, GK Bagó, Cellule, Lithium, GK Petur), in 4 repeats, on 10 square meter random layout plots in the research farm of the Department of Field Crops Research of National Agricultural Research and Innovation Centre, in Szeged-Öthalom. We determined the yield and evaluated our results with analysis of variance according to the different nutrient levels and seeding rates. Increasing the seed density, the yield of winter wheat increased too, in a decreasing rate. Increased nutrient inputs resulted in higher yields. The reaction to the fertilizers was very different among the varieties, we could show different yield order at different nutrient levels and seed density. Our results proved that the use of different varieties and agrotechnical elements cause a big difference in yield, which also determines the economic efficiency of the farm.

Keywords: winter wheat, variety, yield, nutrient level, seeding rate

INTRODUCTION

Winter wheat (*Triticum aestivum* L.) is cultivated on 210-220 million hectares in the world yearly and on 1.1-1.2 million hectares in Hungary. Nearly two-third of the arable land is sown with cereals, which winter wheat is one of the most important. The last years' economical, climatic and cultivar changes gave new jobs to agrotechnical researches in Central Europe. We can ensure or even develop the profitability of winter wheat with changes made in the agrotechnical factors (nutrient supply), with the selection of variety suitable for the area and with the right farming practices (seeding density). HORNOK ET AL. (2006) emphasized particular function of varieties in landscape production. The author revealed that the environmental circumstances are determinative factors in the productivity and yield safety of winter wheat cultivars. Moreover, PEPÓ (1995) and BANIUNIENE AND ZEKAITE (2005) regard the cultivar-growing season relation as of high importance. According to ÁGOSTON AND PEPÓ (2005), the agricultural and physiological speciality of the winter wheat cultivars have more important effect on grain yield than the pathology factors.
Regarding the work of PEKÁRY (1971) the increase of quantity of seeds did not influence the yield of winter wheat. On the other hand, according to RAGASITS (1998) very dense wheat population increases not only the fungal diseases, but the competition between plants also, which finally leads to decrease of the yield.
The research on the nutrient treatment of the winter wheat is versatile and extensive in Hungary. MATUZ ET AL. (2007), TANÁCS (2007) and TANÁCS ET AL. (2006) examined the

effects of fertilizers and fungicide treatments on the quality, while JOLÁNKAI ET AL. (2006) on the quantity of the crop. PEPÓ (2004) proved significant differences among the fertilizer needs, utilization and reaction of the winter wheat cultivars. A dosage of 300-350 kg/ha NPK is the optimum nutrient for winter wheat. This nutrient quantity can modify the ecological, biological and agrotechnical factors. There are significant differences between fertilizer and N reaction of different winter wheat genotypes (PEPÓ, 2014). It is important to improve newer and newer breeds, and to define the optimal nutrient supply and seeding rate of winter wheat varieties, as a result of climate-change habitats, not only from agrotechnical, but also from economic point of view.
In our investigation, we were looking for the answer, whether the seeding density and nutrient supply had any effects on the yield of the different winter wheat varieties.

MATERIAL AND METHOD

The effects of four different nutrient levels (60 kg ha^{-1} N, 0 kg ha^{-1} P_2O_5, 0 kg ha^{-1} K_2O; 90 kg ha^{-1} N, 30 kg ha^{-1} P_2O_5, 30 kg ha^{-1} K_2O; 120 kg ha^{-1} N, 60 kg ha^{-1} P_2O_5, 60 kg ha^{-1} K_2O; 150 kg ha^{-1} N, 60 kg ha^{-1} P_2O_5, 60 kg ha^{-1} K_2O), as well as three different seeding rates (300, 500 and 700 seeds m^{-2}) on different winter wheat breeds have been investigated in this publication. The research was established in one growing season (2017/2018), with 5 winter wheat varieties (GK Arató, GK Bagó, Cellule, Lithium, GK Petur), in 4 repeats, on 10 square meter random layout plots in the research farm of the Department of Field Crops Research of National Agricultural Research and Innovation Centre, in Szeged-Öthalom. We determined the yield and evaluated our results with variance analysis according to the different nutrient levels and seeding rates. The distribution of precipitation in the growing season is shown in *Figure 1*.

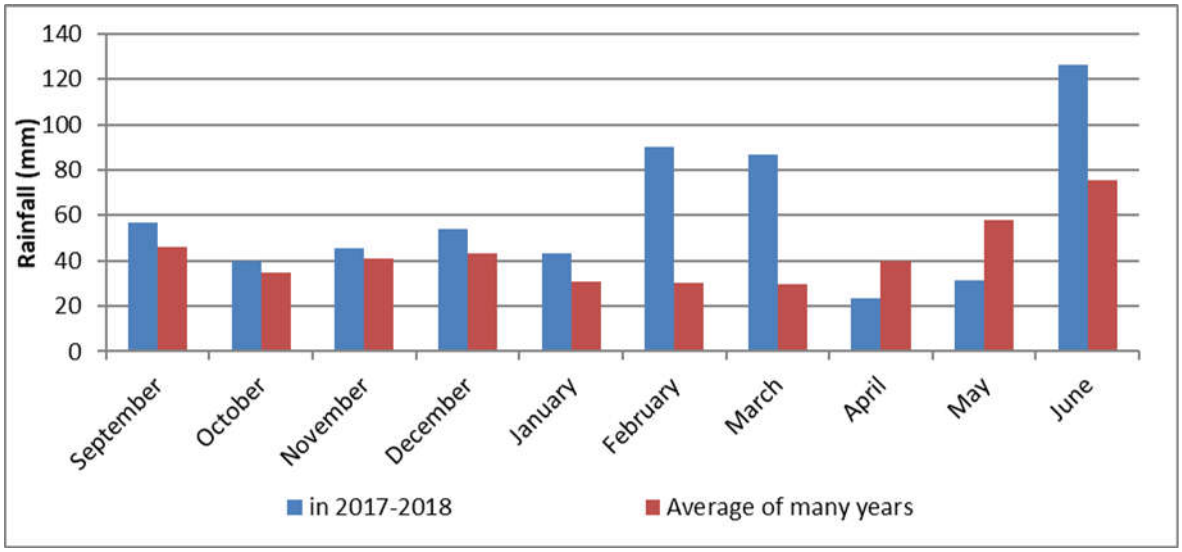

Figure 1. The distribution of precipitation in the vegetative period of winter wheat

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RESULTS

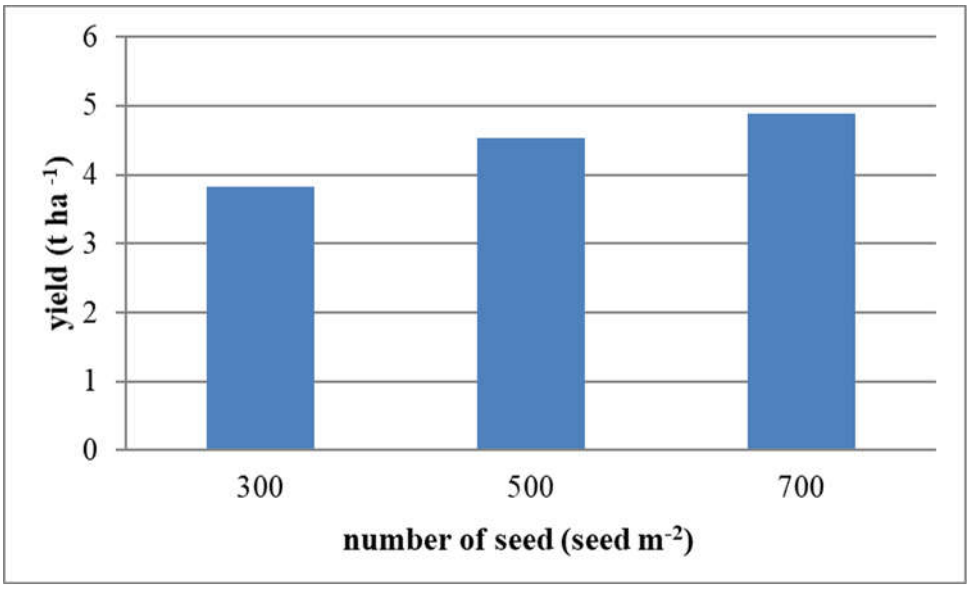

Figure 2. Effect of seed density on yield of winter wheat

In average of varieties and nutrient levels by increasing seed density has reached higher yield of winter wheat in a decreasing rate (*Figure 2)*.

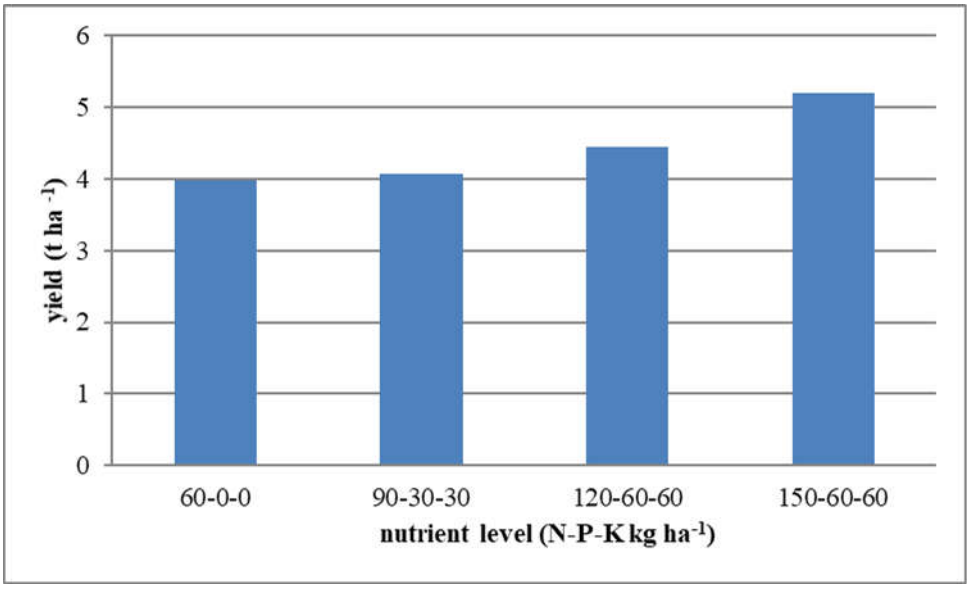

Figure 3. Effect of nutrient level on yield of winter wheat

In average of varieties and seed density by increasing nutrient levels has reached higher yield of winter wheat (*Figure 3)*.

On the plots supplied with only 60 kg ha^{-1} N, compared with the varieties in the average seeding density it can be determined that the highest yield was achieved with the Lithium variety, which produced significantly more than the lowest-yielding Cellule and GK Arató (*Table 1*). Evaluating the seed number, we can see that increased yield increase the seed number, so the difference between the two extreme sowing densities (300 seed m^{-2} and 700 seed m^{-2}) can be statistically proved.

Table 1. Effect of variety and seed number on yield of winter wheat, in different nutrient level

Nutrient level (N-P-K kg ha^{-1})	Seed number (Seed m^{-2})	GK Arató	GK Bagó	Cellule	Lithium	GK Petur	Average	$LSD_{5\%}$
60-0-0	**300**	3.19	3.52	2.79	4.17	3.11	**3.35**	**0.8**
	500	3.67	3.85	3.38	5.05	3.76	**3.94**	
	700	3.98	4.55	4.00	5.58	4.99	**4.62**	
	Average	**3.62**	**3.97**	**3.39**	**4.93**	**3.95**	**1.27**	
	$LSD_{5\%}$	**1.03**						
90-30-30	**300**	3.80	3.78	3.19	4.02	3.73	**3.71**	**0.71**
	500	4.23	4.04	3.85	4.91	3.90	**4.18**	
	700	4.86	3.92	4.52	4.57	3.78	**4.33**	
	Average	**4.30**	**3.91**	**3.85**	**4.50**	**3.80**	**1.12**	
	$LSD_{5\%}$	**0.65**						
120-60-60	**300**	3.88	3.88	3.68	3.91	3.36	**3.74**	**0.84**
	500	4.75	4.40	5.03	4.66	4.24	**4.61**	
	700	5.22	4.35	5.57	5.45	4.25	**4.97**	
	Average	**4.61**	**4.21**	**4.76**	**4.67**	**3.95**	**1.32**	
	$LSD_{5\%}$	**0.76**						
150-60-60	**300**	5.37	4.31	4.13	4.59	4.28	**4.53**	**1.10**
	500	6.55	4.67	5.41	5.51	4.80	**5.39**	
	700	7.39	4.37	6.39	5.71	4.41	**5.65**	
	Average	**6.44**	**4.45**	**5.31**	**5.27**	**4.50**	**1.34**	
	$LSD_{5\%}$	**0.85**						

On the parcels treated with 90 kg ha^{-1} nitrogen, 30 kg ha^{-1} phosphorus and 30 kg ha^{-1} potassium, Lithium produced the highest yields again, while GK Petur produced the lowest yields. There were significant differences between the yields of these two varieties. As the seed density increased, the yield increased, too, but this could not be confirmed statistically.
On the parcels treated with 120 kg ha^{-1} nitrogen, 60 kg ha^{-1} phosphorus and 60 kg ha^{-1} potassium, Cellule produced the highest yields again, while GK Petur produced the least one. There were significant differences between these two yields of the varieties.
On the parcels treated with 150 kg ha^{-1} nitrogen, 60 kg ha^{-1} phosphorus and 60 kg ha^{-1} potassium, GK Arató was the best, and the GK Bagó produced the least. There were significant differences between the yields of GK Arató and the other investigated varieties. Evaluating the seed numbers of the average varieties, it can be determined that increased seed density increase yield, but significant difference could be detected only from 300 seed m^{-2} to 700 seed m^{-2}density.
On 300 seed m^{-1} seed density parcels, compared with the varieties in the average nutrient levels, we could determine that the highest yield was achieved by Lithium and the lowest was found for the Cellule, including a statistically verifiable difference (*Table 2*). Evaluating the nutrient level in the average varieties, it can be determined that the increasing amount of nutrients resulted higher yields. Statistically, it has been proved that the maximum yield is recorded in the parcels of 150 kg ha^{-1} nitrogen, 60 kg ha^{-1} phosphorus and 60 kg ha^{-1} potassium.

Table 2. Effect of variety and nutrient level on the yield of winter wheat, in different seed density

Seed number (Seed m^{-2})	Nutrient level (N-P-K kg ha^{-1})	GK Arató	GK Bagó	Cellule	Lithium	GK Petur	Average	$LSD_{5\%}$
300	**60-0-0**	3.19	3.52	2.79	4.17	3.11	**3.35**	**0.75**
	90-30-30	3.80	3.78	3.19	4.02	3.73	**3.71**	
	120-60-60	3.88	3.88	3.68	3.91	3.36	**3.74**	
	150-60-60	5.37	4.31	4.13	4.59	4.28	**4.53**	
	Average	**4.06**	**3.87**	**3.45**	**4.17**	**3.62**	**1.17**	
	$LSD_{5\%}$	**0.57**						
500	**60-0-0**	3.67	3.85	3.38	5.05	3.76	**3.94**	**0.74**
	90-30-30	4.23	4.04	3.85	4.91	3.90	**4.18**	
	120-60-60	4.75	4.40	5.03	4.66	4.24	**4.61**	
	150-60-60	6.55	4.67	5.41	5.51	4.80	**5.39**	
	Average	**4.80**	**4.24**	**4.42**	**5.03**	**4.17**	**1.16**	
	$LSD_{5\%}$	**0.82**						
700	**60-0-0**	3.98	4.55	4.00	5.58	4.99	**4.62**	**0.92**
	90-30-30	4.86	3.92	4.52	4.57	3.78	**4.33**	
	120-60-60	5.22	4.35	5.57	5.45	4.25	**4.97**	
	150-60-60	7.39	4.37	6.39	5.71	4.41	**5.65**	
	Average	**5.36**	**4.30**	**5.12**	**5.33**	**4.36**	**2.05**	
	$LSD_{5\%}$	**1.03**						

On the 500 seed m^{-1} seed density parcels, compared with the varieties in the average nutrient levels, we could state that the Lithium was the most successful and the weakest performing was GK Petur. The difference in yields between these two varieties is statistically justifiable. Evaluating the nutrient level in the average of varieties, it can be stated that the increasing nutrient levels have resulted in increasing yield. The maximum yield was obtained on the parcels of 150 kg ha^{-1} nitrogen, 60 kg ha^{-1} phosphorus and 60 kg ha^{-1} potassium, which were statistically higher than the yield of the other nutrient levels. On the 700 seed m^{-1} seed density parcels, compared with the varieties in the average nutrient levels, we could state that the maximum yield was achieved by GK Arató, the lowest achieved by the GK Bagó winter wheat variety. Statistically verifiable difference could be found only between these two varieties. Evaluating the nutrient level in the average of the varieties, it can be stated that the maximum yield was obtained on the parcels of 150 kg ha^{-1} nitrogen, 60 kg ha^{-1} phosphorus and 60 kg ha^{-1} potassium, which was statistically higher than 60 kg ha^{-1} nitrogen, 0 kg ha^{-1} phosphorus and 0 kg ha^{-1} potassium yield of parcels and 90 kg ha^{-1} nitrogen, 30 kg ha^{-1} phosphorus and 30 kg ha^{-1} potassium yield of parcels.

CONCLUSIONS

Our results show that increasing the seed density, the yield of winter wheat is increased too, in decreasing rate. From the results of our one-year survey, we can conclude that increasing nutrient inputs resulted in higher yields. The fertilizer reaction of the varieties was very different, we could show different yield order at different nutrient levels and seed densities. Examination of varieties is necessary for variety-specific and production site-specific agrotechnology and precision crop production. The results show that the use of different varieties and agrotechnical elements cause high difference in yield, which also determines the economic efficiency of the farm.

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THE EFFECT OF SEED DENSITY, VARIETY AND SOIL INOCULANT ON THE YIELD OF SOYBEAN

ISTVÁN KRISTÓ[1], MARIANNA VÁLYI NAGY[1], PÉTER JAKAB[2], MELINDA TAR[1]

[1] National Agricultural Research and Innovation Centre, Department of Field Crops Research, Alsó Kikötő sor 9., H-6726 Szeged, Hungary
[2]University of Szeged Faculty of Agriculture, Andrássy str. 15., H-6800 Hódmezővásárhely, Hungary
kristo.istvan@noko.naik.hu

ABSTRACT
The research was established in one growing season (2018), in 4 repeats, on 10 square meter random layout plots in the research farm of the Department of Field Crops Research of National Agricultural Research and Innovation Centre, in Szeged-Öthalom.
In our investigation we used two different seeding rates (40 and 60 seeds m^{-2}) on two soybean varieties (Pannónia kincse, Bahia). This study was carried out in inoculated field soil and non-inoculated field soil. We determined the yield and evaluated our results with ANOVA according to the different seeding density and varieties.
From the results of our one-year survey, we could determine that Bahia had a higher yield than Pannonia kincse, which could be proved at 5% level of significance. Based on this data, we can see that the 60 seeds m^{-2} plots produced higher yields than the lower seed density (40 seeds m^{-2}) plots. The results show that soybean yields increased as a result of soil inoculation.

Keywords: soybean, seed density, variety, soil inoculant, yield

INTRODUCTION

The main goals of crop production experiments are the practical adaptability and the development of profitability. The environmental and landscape protection, but also climatic changes are becoming more and more important, so beside cultivation purposes, particularly the conditions of production site should be taken into consideration by the farmers. In order to maintain sustainability, genotypes with constant yield production and adaptability, as well as high quality parameters are needed.
There are adequate soil conditions in Hungary. Almost 50% of the area of Hungary is arable land, which is unique in Europe regarding its size and quality. The most important natural resource of the country is the ability of agricultural production.
Soybean is one of the most important pulses in Hungary. Although the growing area of soybean is increasing in Hungary, unfortunately our country still needs to import it. Therefore, any research that supports the production of soybean in Hungary can be cause economic benefits. VARGA (1996) determined that ordinary cultivation factors (crop rotation, nutrition, cultivation etc.) had barely changed the yield of soybean, except for the inoculation, which gives yield increase in 15-20% as a result. By KURNIK (1970), inoculation of soybean influenced not only the quantity, but also the quality of yield. According to EGLI (1988), the mechanisms responsible for the observed responses to changing plant density are not well understood. Sowing density and row spacing have a major influence on soybean yields and yield components (COX AND CHERNEY, 2010; LIU ET AL., 2010). Several authors ascribe great importance to the relationship of plant density and variety selection (COOPER, 1989; BOARD AND HARVILLE, 1994; BALL ET AL., 2000). Inoculating soybean with bacteria and mycorrhiza fungi also contributes to nutrient uptake and utilization (YOUNG ET AL., 1986; KOUTROUBAS ET AL., 1989; FATIMA ET AL., 2007).

The aim of our study was to determine the effect of seed density and soil inoculants on the yield of two soybean varieties.

MATERIAL AND METHOD

The research was established in one growing season (2018), in 4 repeats, on 10 square meter random layout plots in the research farm of the Department of Field Crops Research of National Agricultural Research and Innovation Centre, in Szeged-Öthalom.
In our investigation, we used two different seeding rates (40 and 60 seeds m^{-2}) in two soybean varieties (Pannónia kincse, Bahia). This study was carried out in inoculated field soil and non-inoculated field soil. Soil inoculation prepared with a composition containing bacteria and mycorrhiza fungi. We determined the yield and evaluated our results with ANOVA according to the different seeding density and varieties. *Figure 1* shows the distribution of precipitation in the vegetative period of soybean in 2018.

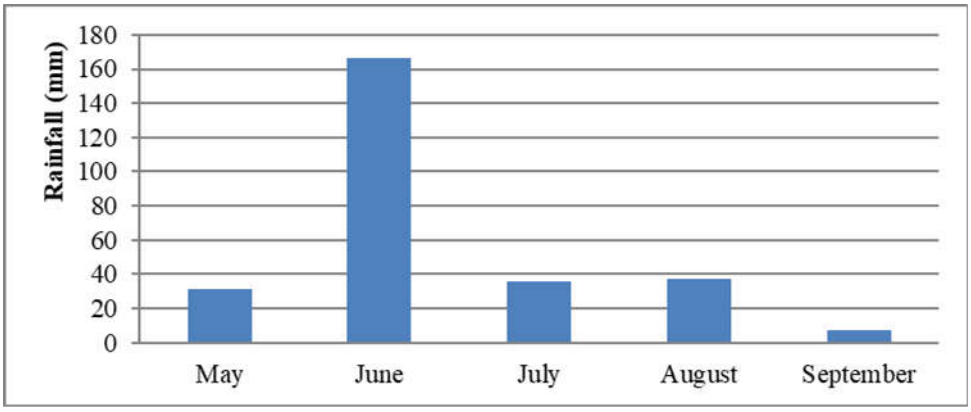

Figure 1. The distribution of precipitation in the vegetative period of soybean

RESULTS

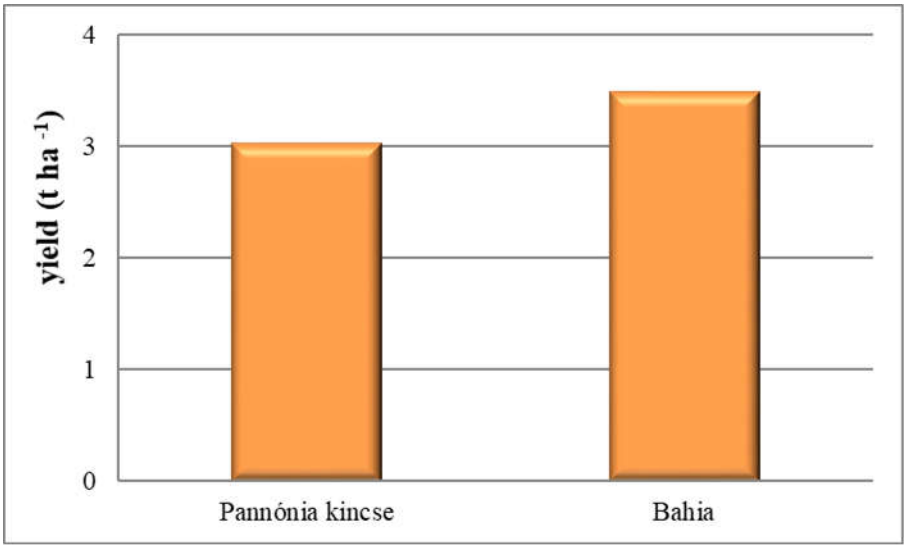

Figure 2. Effect of varieties on the yield of soybean

In our experiment, the yield of Bahia soybean variety was more than 15% higher than the yield of Pannonia kincse (*Figure 2*).

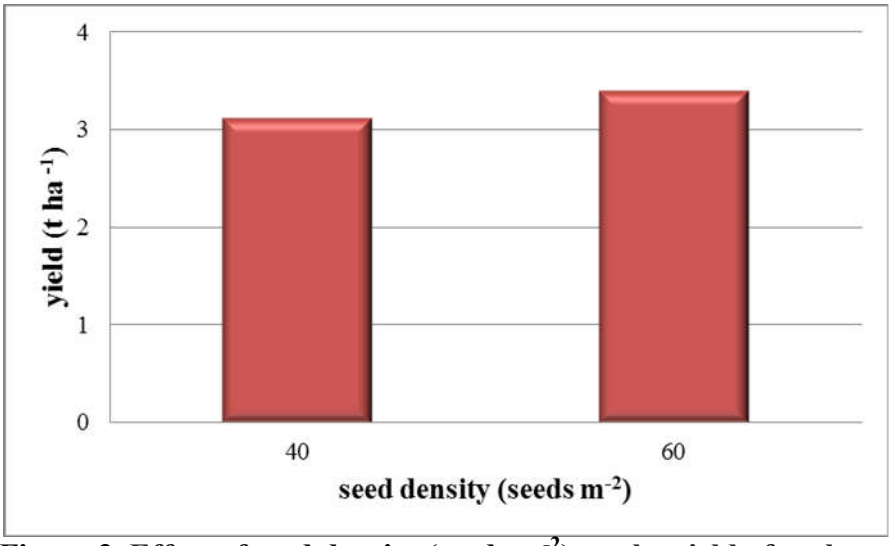

Figure 3. Effect of seed density (seeds m^{-2}) on the yield of soybean

In terms of sowing density, the higher seed density parcels had almost 9% higher yield than the smaller seed density parcels (*Figure 3*).

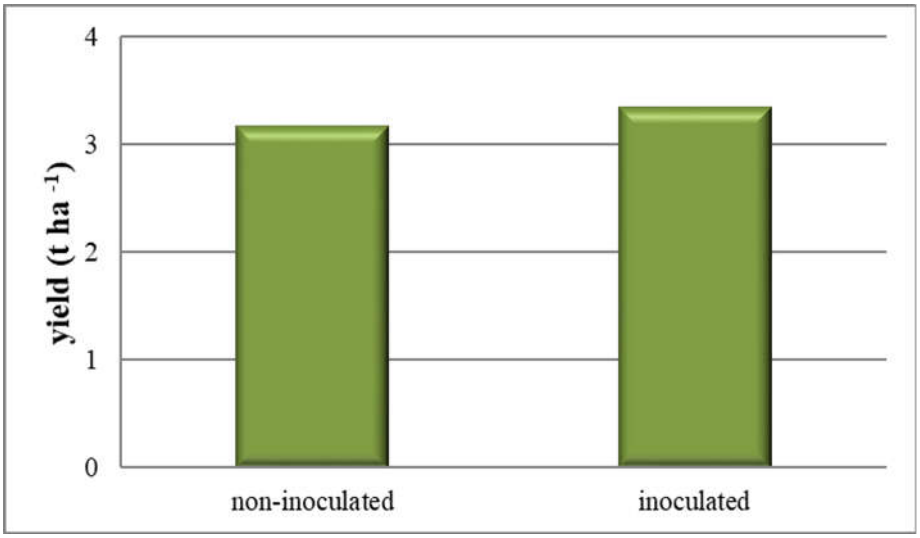

Figure 4. Effect of soil treatment on the yield of soybean

Soil inoculation increased soybean yield by almost 5% - in the average variety and seed density (*Figure 4*).

In the case of the non-inoculated plots, the average seed number of the yield of Bahia soybean variety was 14% higher than the yield of Pannonia kincse, it has significant difference (*Table 1*). In the average of varieties, the 60 seeds m^{-2} plots yield were 9% higher than 40 seeds m^{-2} plots, but we couldn't prove this statistically.

In the inoculated plots, by examining the average seed number, it can be determined that the yield of Bahia soybean variety was 17% higher than the yield of Pannonia kincse, it has significant difference. In the average of varieties, the yield of the 60 seeds m^{-2} plots was 8% higher than in the 40 seeds m^{-2} plots, and we were able to prove this statistically.

Table 1. Effect of variety and seed number on yield of soybean, in inoculated and non-inoculated soil

Inoculation	Seed number (Seeds m^{-2})	Pannónia kincse	Bahia	Average	$LSD_{5\%}$
Non-inoculated	**40**	2.77	3.29	**3.03**	**0.29**
	60	3.14	3.47	**3.30**	
	Average	**2.95**	**3.38**	**0.29**	
	$LSD_{5\%}$	**0.29**			
Inoculated	**40**	2.95	3.47	**3.21**	**0.24**
	60	3.23	3.73	**3.48**	
	Average	**3.09**	**3.60**	**0.24**	
	$LSD_{5\%}$	**0.24**			

Table 2. Effect of variety and inoculant on the yield of soybean, at different seed densities

Seed number (Seeds m^{-2})	Inoculation	Pannónia kincse	Bahia	Average	$LSD_{5\%}$
40	**Non-inoculated**	2.77	3.29	**3.03**	**0.17**
	Inoculated	2.95	3.47	**3.21**	
	Average	**2.86**	**3.38**	**0.17**	
	$LSD_{5\%}$	**0.17**			
60	**Non-inoculated**	3.14	3.47	**3.30**	**0.24**
	Inoculated	3.23	3.73	**3.48**	
	Average	**3.18**	**3.60**	**0.34**	
	$LSD_{5\%}$	**0.34**			

On the 40 seeds m^{-2} parcels, it can be determined that the yield of Bahia soybean variety was 18% higher than the yield of Pannonia kincse, it has significant difference (*Table 2*). In the case of the average of varieties, the yield of the the inoculated plots was 6% higher than that of the non-inoculated plots which is significant difference.
On the 60 seeds m^{-2} parcels, by examining the varieties, it can be determined that the yield of Bahia soybean variety was 13% higher than the yield of Pannonia kincse, it has significant difference. In the average of varieties, the yield of the inoculated plots was 5% higher than in the non-inoculated plots, this difference we couldn't prove statistically.

Table 3. Effect of inoculant and seed density variety on yield of soybean varieties

Variety	Seed number (Seeds m^{-2})	Non-inoculated	Inoculated	Average	$LSD_{5\%}$
Pannónia kincse	**40**	2.77	2.95	**2.86**	**0.12**
	60	3.14	3.23	**3.18**	
	Average	**2.95**	**3.09**	**0.34**	
	$LSD_{5\%}$	**0.12**			
Bahia	**40**	3.29	3.47	**3.38**	**0.38**
	60	3.47	3.73	**3.60**	
	Average	**3.38**	**3.60**	**0.53**	
	$LSD_{5\%}$	**0.38**			

In the case of the Pannonia kincse soybean variety, by examining soil treatments on the average seed number shows that the yield of the inoculated plots was 5% higher than in the non-inoculated plots, which has significant difference (*Table 3*). On the average soil inoculation, the yield of 60 seeds m^{-2} plots was 11% higher than in the 40 seeds m^{-2} plots, which has significant difference.

In the case of the Bahia soybean variety, by examining soil treatments of the average seed number shows that the yield of the inoculated plots was 7% higher than in the non-inoculated plots, which we couldn't prove statistically. On the average soil inoculation, the yield of the 60 seeds m^{-2} plots was 7% higher than in the 40 seeds m^{-2} plots, which has not significant difference.

CONCLUSIONS

From the results of our one-year survey, we could determine that the effect of the different seed density, variety, and soil inoculation characteristics shows high level of differences in the yield of soybean. According to our results, the treatment of seed density has surplus crop up to 7-11%. The 60 seeds m^{-2} plots produced higher yields than the lower seed density (40 seeds m^{-2}) plots. In our study, the right variety choice results surplus yield at a level of 13-18%. Bahia has higher yield than the Pannonia kincse, which could be proved at 5% level of significance. Our results shows that soil inoculants increase the yield of soybean by 5-7% - depending on other treatment.

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INVESTIGATION OF CULLING PRACTICES ON A DAIRY FARM

Violetta Tóth[1], Virág Nagypál[2], Ágnes Süli[1], Edit Mikó[1]

[1]University of Szeged Faculty of Agriculture: Institute of Animal Sciences and Wildlife Management, Address: 6800 -Hódmezővásárhely, Andrássy street 15., Hungary
[2]University of Szeged Faculty of Agriculture: Institute of Economics and Rural Development, Address: 6800 -Hódmezővásárhely, Andrássy street 15., Hungary
toth.violetta@mgk.u-szeged.hu

ABSTRACT

Main aim of cattle breeding is to keep cattles with high productivity in production as long as possible. Thus length of productive lifetime can be increased. Culling is a complex decision. During that age, phases of lactation cycle, milk production, reproduction attributes and health stage all have to be taken into account. Optimal timing is important at culling as too early or too late culling results in economic loss. Culling decision is influenced by economic factors as well such as quantity and price of milk, price of culled cow, purchase price and raising cost of heifer. Many heifer have to be settled into production so all heifer which is suitable for reproduction has to be kept for breeding. As a result of this, all heifer that is healthy in context of reproduction biology has to be taken into breeding. Investigations of this study were made on a Hungarian dairy cattle farm. There is untied system on the farm. Cattles are grouped based on production level and stage of lactation. Daily milking number is three. Culling reasons were analysed in the first three lactations. Based on investigated data, 1175 cow were culled during five years which means 235 cows annually. There were differences between culling reasons. Udder health problems were the main reasons of culling. These presented 30% of the total cullings with 348 individuals. Several individuals were culled without fertilisation in the given lactation. The reason of this could be that the cow did not get pregnant again or other diseases and injuries occurred during lactation period. Most diseases occurred in the first 25 days of second lactation.

Keywords: dairy cattle, culling, replacement heifer, Holstein-Friesian

INTRODUCTION

Culling is a complex decision. During that age, phases of lactation cycle, milk production, reproduction attributes and health stage all have to be taken into account (BEAUDEAU, 1995). Reproduction disorders, mastitis, low milk yield and lameness are the principla causes of culling (BASCOM – YOUNG, 1998; CHIUMIA ET AL. 2013). Kerslake et al. (2018), calculated that reproduction disorders, mastitis and different diseases and mechanic injuries mean 10 dollar extra costs cow/year. According to them it would be important for the dairy farms to pay more attention on veterinarian treatments, genetics, production control and economic factors. Beaudeau et al. (1995), found that animal health problems has been identified as reason of half of the cullings. Nowadays, prevention has become more important than treating diseases (DERKS, 2014). It is typical for Hungary that cows are culled after 2,2-2,3 lactations on average. Therefore, all reproductive, biologically health heifers should be bred (HOLLÓ - SZABÓ, 2011).

MATERIAL AND METHOD

The research was carried out in a dairy farm in Hungary. Holstein Friesian is the type of the herd. There are 475 cows. There is untied keeping system on the farm and the litter is straw. Cows are grouped according to production level and lactation phase. On the dairy farm the cows are milked three times a day. Milking parlour is parallel type.

Description of investigation

During the research the development of the culling reasons in the given herd were examined. More detailed research were made on culling due to mastitis. The somatic cell count of cows suffering from mastitis has been shown. Proportion of somatic cell number of cows in the first three lactation was analysed too. Further questions were answered as well like how many times cows get ill and in which phase of lactation disease first occure most frequently. Mastitis was detected by Californian Mastitis Test in all cases. Cows suffering from mastitis are isolated and separately milking them. Data about their productivity, medical treatment was recorded and stored in farm monitoring system. Data were gained from RISKA farm monitoring system. SPSS for Windows 18.0 program was used for the analysis. Data was processed and summarised in diagrams.
The applied statistical methods are shown in *Table 1.*

Table 1. Statistical methods applied for investigation

Applied statistical methods		**Investigated area**
Chi^2 probe	Testing coherence between variables	%-based distribution of culling reasons in each lactations Serial number of fertilisations depending on lactations
Cross-Tabulation Analysis		

RESULTS

Data on the basics of the examination was collected between 2013 and 2017. The *Figure 1.* presents the distribution of culling reasons during the investigated period which was 5 years.

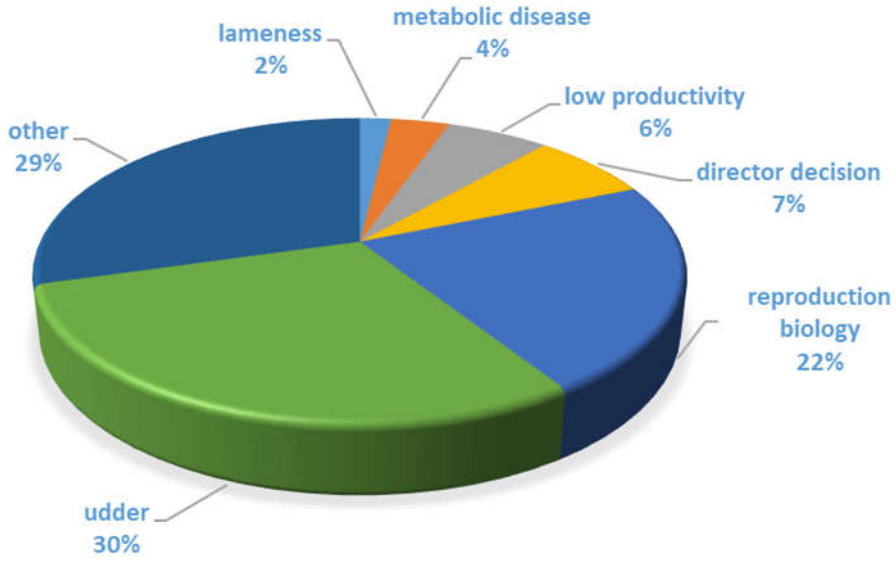

Figure 1. General investigation of culling reasons in the herd

All in all 1175 individulas are considered. There are significant differences between culling reasons. Mastitis takes the first place giving 30% of total. The second highest portion of culling were other reasons such as lung inflammation, cardiac arrest, weakness, heat stress, mechanic injuries. 22% of cullings was caused by reproduction biology disorders. Low productivity, lameness, and metabolic diseases caused 12% of culling.

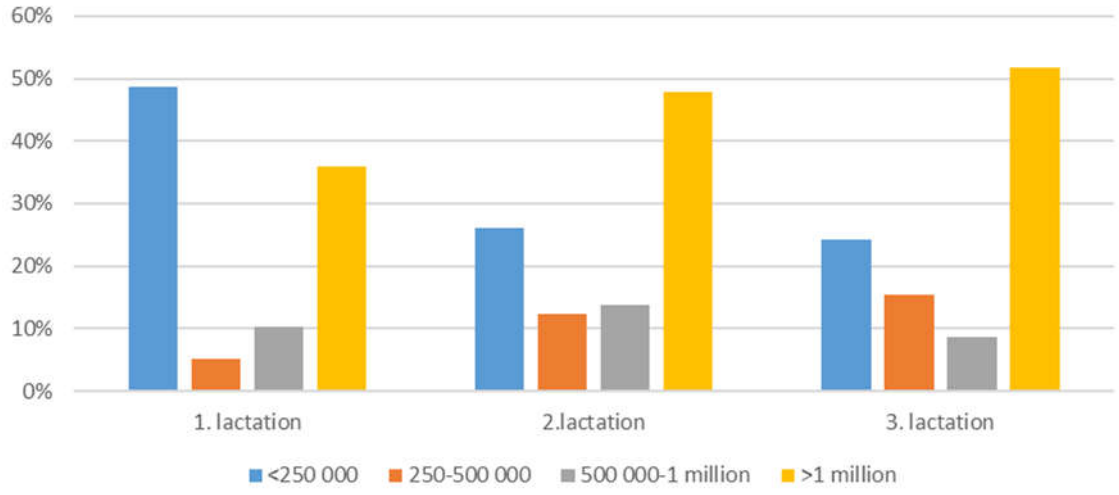

Figure 2. Distribution of somatic cell count in the first three lactation

Distribution of somatic cell count in the first three lactation is presented in Figure 2. The highest ratio of somatic cell count (SCC) was bellow 250 000 cell/ml in the first lactation. Values between 250-500 000 cell/ml just reached 5 %. 10% was the proportion of 500 000-1 million cell/ml. The second highest ratio of SCC was above 1 million cell/ml meaning approximately 36 %. As sum of these, lower than 250 000 SCC was typical. The second highest ratio was above 1 million SCC. In the second lactation approximately 50%

reached above 1 million SCC. Cell count bellow 250 000 meant 26%. SCC between 250 000 and 500 000 and 500 000-1 million exceeded 10%. Milk SCC of cows after culling in the third lactation exceeded 1 million cell count by almost 52%. SCC bellow 250 000 meaning 24% had SCC between 250 000 and 500 000 was observable in 15.5%. Proportion of the 500 000-1 million cell/ml value did not exceed 10%. As a conclusion, milk of cows after culling had more than 1 million SCC considering the highest proportions excluding the first lactation. Result of statistical probe presented significant difference in the distribution of observed indicators (Chi^2=20.903, df=6, p=0.002).

Table 2. Day of the first disease is signed by calving number in % in the given lactation

	Day of the first disease occurrence in lactation						
Calving number	<= 25	26 - 50	51 - 100	101 - 150	151 - 200	201+	Total
1	13.4	0.4	3.2	2.5	2.1	4.2	25.7
2	16.5	2.5	7.0	3.5	1.8	3.5	34.9
3	11.6	2.5	2.8	1.4	2.1	2.8	23.2
4	3.9	0.7	2.5	0.4	0.4	1.8	9.5
>4	5.6			0.4	0.4	0.4	6.7
Total	51,1	6.0	15.5	8.1	6.7	12.7	100.0

Table 3. shows that the most diseases occurred after the second lactation representing 34.9%. After the first and second calving diseases occurred diseases occurred with similar ratio; 25.7 and 23.2%. The most diseases occurred in the first 25 days of lactation meaning 51.1%. 16.5% of this value occurred after the second calving. 13.4% of individuals got ill after the first calving. Ratio of diseases decreased between 26 and 50th day of lactation meaning 6%. Ratio of diseases was higher after the second and third calving. Between 51th and 100th days, ration of diseases started to increase meaning 15.5%. It is visible from data, that in this phase the highest ratio of diseases occurred after the second calving with 7%, then 3.2% got ill after first calving. Between 101th and 150th days of lactation, ratio of diseases decreased till 8.1%. In this phase, the most diseases occurred after the second calving. Between 151th and 200th days of lactation disease ratio decreased again. However after day 200th there was increment again. In the last phase of lactation 12.7% of all individuals got ill. In this phase the most frequent ratio of illnesses occurred after the first calving representing 4.2%. As a conclusion, the most diseases occurred after the first three calving meaning 83.8%. Considering phase of lactation more than half of the individuals got ill in the first 25 days firstly. After this decreasing tendency was typical considering firstly appeared diseases excluding 51- 100th days of lactation. New increment occurred after the 200th day. There was significant difference in the distribution of investigated indicators after statistical probe was made (Chi^2=24.920, df =20, p=0.205).

CONCLUSIONS

According to BASCOM AND YOUNG (1998) and CHIUMIA ET. AL (2013) preliminary culling reasons are reproduction disorders, mastitis, low productivity and lameness. In this research all appeared but with different order. Mastitis took the first place, then were other diseases, injuries. The third main reason was reproductive disorders. Low productivity and lameness ocurred in low percentage. Dairy cows can also be culled during lactation and

mastitis can occurs at any phase of lactation (GRÖHN ET AL. 1998). SHOOK AND SCHUTZ (1994) found that is somatic cell count increases it is related to mastitis. Based on the results somatic cell count of culled cows was above 1 million in every cases. The rate of the SCC above 1 million cells/ml in the milk is increased with lactation number. From this it can be concluded that the cullings were mainly caused by clinical mastitis. This is supported by HARASZTI's (1996) statement; he says if the somatic cell count is above 1 million we can speak of clinical mastitis. According to ALHUSSEIN AND DANG (2018) considered this value between 500 000 – and 750 000 cell/ml. Mastitis also has a dangerous effect on health and production of the animal (MÜLLER- SAUERWEIN, 2010). Mastitis is the most common and costly disease of dairy cows (HALASA ET AL. 2007; HOGEVEEN ET AL. 2011). Mastitis often causes early culling (ANSARI-LARI ET AL. 2012). Research found that the rate of culling should be reduced, especially with regard to mastitis. Thus length of productive lifetime can be increased. As a result, the genetic potential of cows would be better expolited and production costs would be reduced.

Holstein Friesian has become the world's best dairy cow recently. In addition to outstanding milk production there are many animal health problems, because this species has particularly sensitive constitution. The most cullings are caused by different diseases. Based on the results and the literature it was found that if the anount of culling can be reduced, milk production will be more efficiently and profitably. To do this, it is important to prepare veterinary management and increase professional knowledge, furthermore ask expert advice. The most cullings occured due to mastitis. Strict adherence to a well-developed udder health program helps to prevent mastitis. Thus higher production of the herd will appear if the culling proportion decreases.

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SHORT FOOD SUPPLY CHAINS AS OPPORTUNITIES FOR HUNGARIAN PARAGASTRO SOCIAL ENTERPRISES

ÁRON TÖRÖK[1], IRMA AGÁRDI[2]

[1]Corvinus University of Budapest
Department of Agricultural Economics and Rural Development
1093 Budapest Fővám tér 8.
aron.torok@uni-corvinus.hu

[2]Corvinus University of Budapest
Department of Marketing
1093 Budapest Fővám tér 8.

ABSTRACT
In the recent years the alternative food networks gained a significant importance, mainly due to the need of consumers to get closer to the farmers both in terms of physical distance and in number of intermediaries. The concept of building a reliable food system tries to balance the mistrust in the industrialized food production that is dominating in the developed countries. Social enterprises are enterprises pursuing primarily social objectives in business environment. In 2015, in Hungary more than 13.000 social enterprises were registered according to the statistics with many different social missions. However, the number of social enterprises in the catering sector is quite limited. The Hungarian para-gastro movement consists of 7 different organisations, operating in the catering sector and employing handicapped and/or disabled workforce. Against this background, in our paper we would like to investigate the business models of Hungarian social enterprises in the catering sector, somehow connected and related to short food supply chains. To the best of our knowledge, currently only 3 companies fulfil all these criteria: Ízlelő Restaurant from Szekszárd, Hatpöttyös Restaurant from Székesfehérvár and the Batyu-Téka from Miskolc. In order to understand the business models of these three companies, we applied an expert interview based, qualitative approach. We also analysed the publicly available financial statements of them and calculate the most important (financial) ratios. Altogether we tried to analyse the role of direct sourcing, the niche market of local foods and obviously the advantages and the disadvantages of the social entrepreneurship. Results show that currently the social enterprises requires (state) subsidy to survive, the average share of subsidies was 19-49% of the total income among the investigated companies. However, all have their unique way to pursue the survival and the level of commitment to short food supply chains is very different. Altogether we could identify possible synergies where social gastro enterprises can benefit from direct sourcing.

Keywords: social innovation, short food supply chain, paragastro social enterprises

INTRODUCTION

Short food supply chains (SFSC) try to solve the recent problems of the modern food industry manifested in several food scandals (e.g. salmonella infections, BSE crisis, dioxin residues etc.). SFSCs are defined as an initiative focusing on informative food products instead of anonym mass products (MARSDEN ET AL., 2000). In the classification of the several types of SFSC (MARSDEN ET AL., 2000; RENTING, MARSDEN – BANKS, 2003) restaurants using local food resources are considered as quasi-local supply chains connecting the local producers with the final consumers. These restaurants provide conveniently fresh and healthy food products for their consumers. Consumers value both the fresh and healthy food and restaurants with SFSC suppliers can meet these expectations (CRAVEN – KREJCI, 2016). The producers can also benefit from this cooperation as many

restaurants demonstrated their eagerness to seek out and pay premiums for trusted and transparent inputs (Fleury et al., 2016). On the other hand, this could be also an opportunity for small producers, as in these cases the entry barrier is lower for small and beginner farmers, who are often scaled-out of the restaurant market by the volume requirements of food service distributors (GIVENS – DUNNING, 2018).

Social innovations can be considered as the interaction between social and market economy enabling autonomous evolution (LAVILLE – NYSSENS, 2001). These initiatives are new solutions that are suitable for satisfying collective needs (MOULAERT, 2010). The collective activities and social transformation help to develop new governance mechanisms, create and legitimize communities, enforces participation and develops new capabilities (MULGAN ET AL., 2007).

In 2015, in Hungary more than 13.000 social enterprises were registered according to the statistics with many different social missions (G. FEKETE ET AL., 2017). However, the number of social enterprises in the catering sector is quite limited. The Hungarian para-gastro movement consists of 7 different organisations, operating in the catering sector and employing handicapped and/or disabled workforce.

In this research we would like to investigate the business models of Hungarian social enterprises in the catering sector, somehow connected and related to short food supply chains. To the best of our knowledge, currently only 3 companies fulfil all these criteria: Ízlelő Restaurant from Szekszárd, Hatpöttyös Restaurant from Székesfehérvár and the Batyu-Téka from Miskolc.

MATERIAL AND METHOD

The research used a qualitative approach by applying expert interviews of selected paragastro enterprises' stakeholders and their suppliers. The three firms selected all fulfil social objective by employing disabled workforce in the catering sector. The three companies (Ízlelő Restaurant, Hatpöttyös Restaurant, Batyu-Téka) operate in several parts of Hungary, in the Southern-Danubian Region, in the Central-Danubian Region, and in Northern Hungary, respectively, and their main characteristics are summarized in *Table 1.*

In order to deeply analyse the business model of the selected companies we also investigated the financial statements to get comparable financial indicators.

Table 1. Main characteristics of the selected paragastro firms

	Ízlelő Restaurant	**Hatpöttyös Restaurant**	**Batyu-Téka**
Location	Szekszárd	Székesfehérvár	Miskolc
Main activity	restaurant + catering	restaurant + public catering	public catering + restaurant
Year of foundation	2009	2009	2007
Market activity	education	education	social care
Social focus	employment of disabled and/or handicapped people		
SFSC relation	local suppliers	local suppliers + box scheme	own inputs

RESULTS

The selected paragastro companies are all operating in the catering sector and all related somehow to the local food suppliers but their business models are quite different.

In case of the Ízlelő Restaurant, the main strategy is to focus on the top quality gastronomy. Their niche market is to reach health conscious consumers that are willing to pay a higher price for products made from high quality inputs. They use only unprocessed raw materials requiring more labour and the share of the local inputs reaches 60-70% during the summer season while in wintertime it is 30-40%. In a franchise system they plan to open their second restaurant in Budapest.

The Hatpöttyös Restaurant focuses on the daily lunch catering, also serving as public caterer. Due to quality and quantity issues their attachment to local suppliers decreased recently, only meat products and seasonal fruits are purchased locally. They also used to host a community supported food basket scheme as an exchange point.

Batyu-Téka is highly involved to public catering and they also owns their social farms where several inputs (mainly fruits, vegetables and dairy products) of the restaurant is produced, representing 20% of the total supply. The company faces with high price competition as their competitors get direct subsidies in the public catering, therefore they cannot afford to buy other local inputs than their own production.

The financial performance of the companies (indicated in *Table 2*) clearly shows that the paragastro companies heavily depend on subsidies received from national and/or EU funds. However, the high level of subsidies usually covers the loss of the business operations: out of the three selected firms the one with the highest share of real market incomes seems to be financially viable. On the other hand it should be bear in mind that the social goal (employing disabled and/or handicapped workforce) is reached by all the companies.

Table 2. Financial characteristics of the selected companies

	Ízlelő Restaurant	Hatpöttyös Restaurant	Batyu-Téka
Revenues from market activities (average, million HUF)	14.7	16.5	33.9
Total revenues (average, million HUF)	22.5	30.3	70.5
Share of subsidies in total revenues	19%	44%	49%
EBIT (average, million HUF)	2.3	-3.2	-0.1
Number of business years with profit	9/9	2/6	7/10
Number of employees	7	18	21
Per capita subsidies (average, million HUF)	0.6	0.8	1.7
Per capita gross margin (average, million HUF)	0.8	-0.2	-0.1

CONCLUSIONS

Based on the expert interviews and the financial analysis, paragastro companies can benefit from both their social innovation and the SFSC commitment. The possible interactions are summarized in *Table 3.*

The high entry barriers of the catering sector can be compensated by low rental fees provided by the local governments and their support is usually socially validated. The high cost of the workforce accessibility (e.g. when the restaurant staff is with wheelchair) can be covered by EU funds. The low labour productivity of the handicapped workforce often accompanied with loyalty, the grateful employees makes the level of fluctuation very low that is unique in the catering sector. On the other hand, using (exclusively) unprocessed inputs requires higher labour intensity that can be covered. Due to the inputs coming from SFSC a more health conscious consumer segment can be marketed with higher prices that can compensate the higher cost levels. Last but not least the supplementary, labour intensive activities (e.g.: chocolate manufacture in the Ízlelő Restaurant, goat cheese production in Batyu-Téka) can be considered as additional income sources where the employees can get involved for a meaningful but also market oriented value creation.

In sum, the Hungarian paragastro social enterprises can find their ways combining social innovation with short food supply chains, however the individual approaches have to be adjusted according to the local and organizational characteristics.

Table 3. Possible interactions

	Social innovation	SFSC
High entry barriers	support of the local municipalities	-
Workforce accessibility	EU funds	-
Low labour productivity	support for training low level of fluctuation	using (exclusively) unprocessed and/or local inputs
Targeting niche markets	-	higher prices because of healtier and more sustainable inputs
Supplementary, labour intensive activities	-	food manufactories

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GI EXPECTATIONS IN THE HUNGARIAN FRUIT INDUSTRY THE CASE OF TWO HUNGARIAN CHERRIES

ÁRON TÖRÖK

Corvinus University of Budapest
Department of Agricultural Economics and Rural Development
1093 Budapest Fővám tér 8.
aron.torok@uni-corvinus.hu

ABSTRACT
In the agrifood policy of the European Union (EU), Geographical Indications (GI) are considered as one of the most important quality indicators. The European system consists of two parallel classifications: Protected Designations of Origin (PDO) and Protected Geographical Indications (PGI). The main beneficiaries of the system are the Mediterranean countries of the EU, both in terms of number of registered products and their economic importance. On the other hand, Central and Eastern European countries have remarkable lag. In Hungary, most of the GI products have very limited economic value and though the products usually have wide reputation, they are rather confined to the domestic market.Soon two Hungarian cherries will be registered in the EU GI system, one PDO (Szomolya cherry) and one PGI (Nagykörű cherry). The aim of the paper is to analyse the expectations of the Hungarian cherry industry regarding the GI recognition. In order to have an ex-ante examination of the research question, 22 semi-structured interviews were conducted with all the stakeholders (producers, GI consortiums, policy makers and other related experts). Results suggest that the possible success of these products stands on the strong cooperation among the producers and the high level of domestic reputation. In short term, a more stable market share; while on long term increasing prices and export possibilities are expected. However, it also became clear that the benefits of the GI recognition can only be expected if additional improvements in infrastructure (e.g. storing and processing capacities) and in marketing (e.g. using the PDO/PGI label) are also carried out.

Keywords: geographical indications, cherry, protected designation of origin, protected geographical indication

INTRODUCTION

In the EU, the food quality policy is highly linked to the system of Geographical Indications, however its economic importance is quite unclear as the number of empirical papers focusing on this aspect is limited. (TÖRÖK & MOIR, 2018). It has two main components. Protected Designations of Origin (PDOs) have very similar characteristics to the already existing French Appellation d'Origine Contrôlée (AOC) and Italian Denominazione d'Origine Controllata (DOC) systems (ILBERY, KNEAFSEY, & BAMFORD, 2000; LAMARQUE & LAMBIN, 2015). Protected Geographical Indications (PGIs) have a German origin and have a strong reputational element but lesser link to terroir (GANGJEE, 2006). Per definition, in case of a PDO product, "the quality or characteristics are essentially or exclusively due to a particular geographical environment with its inherent natural and human factors", while for PGI products the "quality, reputation or other characteristic is essentially attributable to its geographical origin". (EUROPEAN PARLIAMENT, 2012, P. 8)

In some South-European countries, the concept of linking quality of a product to its geographical origin has a long history but the EU has its community level system since 1992. The number of Hungarian GI products (see *Table 1*) in the official EU register (DOOR database) is quite limited, by the end of 2018 altogether 14 products are registered (6 PDO + 8 PGI) (EUROPEAN COMMISSION, 2018). The current Hungarian GI products are

mainly (processed) meat products (5), fresh vegetables (4) and spices (3) and only 1 fruit (Gönci apricot) is on the list. In 2015, the Hungarian government started a GI program in order to increase the number of the Hungarian GI products and to help the existing GI products to benefit more from the EU GI system. The basis for the new GI products is the list of Hungarian agricultural and food products in possession of the national food quality label TTR (Traditions, Tastes, Regions) (DARVASNÉ ÖRDÖG, 2018). Since the introduction of the Hungarian GI program, 14 new registrations are initiated (11 PGI and 3 PDO), mainly fresh fruits (6). Two Hungarian cherries are included to this list, Szomolyai cherry (PDO) and Nagykörűi cherry (PGI).

Table 1. Hungarian GI products in the EU DOOR register based on EUROPEAN COMMISSION (2018)

Denomination	Product category	Status
Szegedi fűszerpaprika-őrlemény/Szegedi paprika	PDO	Registered
Kalocsai fűszerpaprika-őrlemény	PDO	Registered
Makói petrezselyemgyökér	PGI	Registered
Makói vöröshagyma; Makói hagyma	PDO	Registered
Magyar szürkemarha hús	PGI	Registered
Szegedi szalámi; Szegedi téliszalámi	PDO	Registered
Csabai kolbász/Csabai vastagkolbász	PGI	Registered
Gyulai kolbász/Gyulai pároskolbász	PGI	Registered
Gönci kajszibarack	PGI	Registered
Szentesi paprika	PGI	Registered
Budapesti téliszalámi	PGI	Registered
Hajdúsági torma	PDO	Registered
Alföldi kamillavirágzat	PDO	Registered
Szőregi rózsató	PGI	Registered
Szilvásváradi pisztráng	PGI	Pending
Jászsági nyári szarvasgomba	PGI	Pending
Keleméri bárányhús	PGI	Pending
Nagykörűi ropogós cseresznye	PGI	Pending
Nagykun rizs	PGI	Pending
Budaörsi őszibarack	PGI	Pending
Őrségi tökmagolaj	PGI	Pending
Akasztói szikiponty	PDO	Pending
Újfehértói meggy	PGI	Pending
Tuzséri alma	PDO	Pending

Szomolyai rövidszárú fekete cseresznye	PDO	Pending
Győr-Moson-Sopron megyei Csemege sajt	PGI	Pending
Balatoni hal	PGI	Pending

Note: status on 15th November 2018.

MATERIAL AND METHOD

In order to have a comprehensive view of the Hungarian cherry industry and to evaluate the opportunities of the two GI candidate varieties, a qualitative approach with semi structured interviews were initiated. The interviews (*Table 2*) with the stakeholders focused on several topics: expectations toward price, market share, reputation, market orientation, export opportunities, labelling, governance and spill over effects (e.g. farm tourism).

Table 2. Summary of the interviews.

Interviewee	Number of interviews	Remarks, key focus areas
cherry producers	14	3 cherry producers of Szomolyai cherry PDO 5 cherry producers of Nagykörűi cherry PGI 6 cherry producers from other parts of Hungary with no GI production
GI consortiums	2	the leaders of the GI cherry consortiums
local stakeholders	2	1-1 person in charge of the local municipality of Szomolya and Nagykörű
policy maker side	2	the GI rapporteurs of the cherries in the Ministry of Agriculture (1+1 person) the deputy state secretary
Hungarian Vegetable and Fruit Association	1	Vice president, responsible for fruit division
Fruitculture Research Institute of Hungary	1	Main characteristics of the selected varieties, possibilities for improvements

RESULTS

Cherry is an important fruit of Hungary, both economically and emotionally. However, the cherry producers are not well organized, there is no cooperation, the biggest producers export their top quality products directly, however the most important sales channel is the wholesale market and selling to (foreign) collectors on farm. The most important market requirement for cherry is the size of the fruit, taste almost doesn't matter. The average size with extensive production is 24-28 mm and these fruits can be sold only to domestic market. The first class requirement is 28+ mm while for export a size of 30-32+ mm is required. (APÁTI, 2012)

The Nagykörű PGI cherry is harvested on approx. 230,5 ha of plantation (ca. 8,5% of the total Hungarian cherry plantation in this single settlement) but mainly from very small and fragmented cherry farms. Breed varieties of Germersdorfer and Carmen represent 70-80%

of the total plantations and these are mainstream varieties in Hungary – therefore they are produced in the biggest amount and can be sold only with moderate prices. The GI Code of Practice for Nagykörű PGI cherry includes 7 varieties of which only 3 are produced in bigger quantity among the producers (Germersdorfer, Carmen and Bigarreau Burlat), the share of the other varieties are quite limited. Because of the favourable conditions for cherry cultivation in Nagykörű with less intensive cultivation methods, relatively large sized fruits can be produced that makes cherry production popular and profitable here. In Nagykörű somehow everyone is connected to cherry production, in the harvesting season the cherry sector is dominant in the region also in terms of employment. On the other hand, plantations are very fragmented and only ca. 50 families have dominant income from cherry production

The Szomolya PDO cherry is produced on approximately 50 ha in the municipality of Szomolya and in the other 6 eligible settlements. The biggest producer (20 ha) and the Local Municipality of Szomolya (10 ha) owns more than half of the total cherry plantation. Another 7-8 farmers produce cherry professionally while all the others are fragmented cherry farms with small average size. In Szomolya the geological and environmental characteristics of the region are very favourable for cherry production and mainly because of the soil, the nutrient content of the fruit is very special (very high flavonoid content and very dark colour) and the connection between soil and flavonoid content is scientifically proven. This makes the Szomolya cherry (produced in the region of Szomolya) unique. However, more cherry with name of "Szomolya black cherry" is produced outside of the region than in Szomolya, though their quality is inferior compared to the original ones

CONCLUSIONS

The number of cherry varieties in possession of GI labels is very limited, only 8 varieties of Mediterranean EU member states (Greece, Italy, Portugal and Spain) have their own. After the registration, Hungary will be the only country not from this region with GI cherries (*Table 3*).

Table 3 GI cherries in the European Union based on European Commission (2018)

Name	Country	Type	Variety scope
Kerassia Tragana Rodochoriou	Greece	PDO	1 variety (local)
Ciliegia dell'Etna	Italy	PDO	1 variety (local)
Ciliegia di Marostica	Italy	PGI	19 varieties (mainstream)
Ciliegia di Vignola	Italy	PGI	30 varieties (mainstream)
Cereja da Cova da Beira	Portugal	PGI	7 varieties (mainstream)
Cereja de São Julião-Portalegre	Portugal	PDO	1 variety (local)
Cerezas de la Montaña de Alicante	Spain	PGI	8 varieties (mainstream)
Cereza del Jerte	Spain	PDO	5 varieties (local)
*Szomolyai rövidszárú feketecseresznye**	*Hungary*	*PDO*	*3 varieties (local)*
*Nagykörűi ropogós cseresznye**	*Hungary*	*PGI*	*7 varieties (mainstream)*

Note: * GI registration is pending

The list above well indicates the spirit of the EU GI regulation: PDO cherries are usually local varieties produced in limited area with very special attributes (e.g.: special colour,

unique contents) that makes the product unique. On the other hand, PGI cherries are usually mainstream varieties, produced all around the world and have their desirable attributes (mainly the big or very big size) because the endowments of cherry production are very preferable in the PGI region.

The two Hungarian cherries are in line with these characteristics, the Szomolya PDO cherry has great reputation because of its high sugar and flavonoid content and black colour, while the Nagykörű PGI cherry is famous of its big size and crispiness.

Both Hungarian cherries could benefit from the GI registration, but different strategies should be followed. Common requirement of both cherry producing region is the cooperation as the post-harvest manipulation (sorting, cooling, packaging etc.) required for the marketable cherry supply chain requires much more capital investments that would be suitable for a typical individual cherry producer in Hungary (with an average plantation size of several hectares). On the other hand, the specific strategies are quite different for these two cherry producing regions.

Nagykörű PGI cherry has to compete with generic cherries in terms of volume of sale, size of the fruits and price. As the space for cherry plantation eligible for the GI requirements is limited, the volume of sale could be increased only via intensification of the existing plantations with replacements and better care of the neglected territories. The producers currently have to face with very low prices due to the low level of bargain power. The producers try to sell their products individually, obviously in smaller quantity. The requirement of cooperation for the GI initiative might have a positive influence on the selling practices of the producers. Other changes might be derived from changing the sales channels and increase the level of processing. The long term increase of reputation because of the GI label might help the producers to bypass intermediate players of the market and to participate in short(er) food supply chains, that might also result in higher prices. Currently, there is not enough labour capacity to process cherry, mainly because of the labour intensity of the harvest. In case of processing, the collaboration or the manufacturization of the work process can be a solution. The Nagykörű cherry spirit (also PGI to be) can be an example for other cherry products (e.g.: jam made of PGI Nagykörű cherry). Export markets could be reached if the size of the fruit meets the export quality size, otherwise the reputation of the Nagykörű cherry only exists within Hungary.

On the other hand, the Szomolya PDO cherry has unique characteristics among cherries and it was recognized many decades ago in the Hungarian fruit industry. The high reputation of the variety was recognized and cherry producers all around Hungary wanted to benefit from this by producing the Szomolya variety outside of the original region. However, the unique content of the fruit is linked to the soil of the PDO region therefore the main goal of the GI registration is to regain the exclusivity of the name of Szomolya cherry. The PDO label could be a suitable tool for it. Once this expectation is met, based on the unique characteristics of the fruit an increase in production volume (through re-involving the neglected cherry plants) can be achieved and can be exported, mainly as processed products.

However, it should be bear in mind that for the producers the concept of GI label is a sort of marketing tool that could be only beneficial if it is actively and widely used by the eligible producers. Both cherry regions are entitled to use the national food quality label TTR (Traditions, Tastes, Regions), however in practice almost no producers indicate it. Therefore, the GI protection can only benefit the producers in case they believe in the concept and get actively involved with it.

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MORPHOMETRIC AGE AND SEX IDENTIFICATION OF EURASIAN COLLARED DOVES (STREPTOPELIA DECAOCTO FRIV.) – A PILOT-TEST

SÁMUEL ZSOLT VARGA – LAJOS JUHÁSZ

University of Debrecen Faculty of Agricultural and Food Sciences and Environmental Management Department of Nature Conservation Zoology and Game Management, 138. Böszörményi út, Debrecen, Hungary 4032

varga.samuel@agr.unideb.hu

ABSTRACT

In this research, our main goal was to test, if there is an effective, yet economical way to perform native sexing on *Columbidae* species in field conditions. Since molecular sexing is not available among field conditions, a morphometric method was aimed to be used. After morphometric measurements, autopsy was performed to determine the sex of collected birds. The novelty of the method is that we added a new measure point to improve age and sex determination. The method was tested on Eurasian Collared Doves (n=18). Our result showed that the gap of pubic bones is highly correlated to age and most of the main morphometric data, despite the low sample number.

Keywords: age determination, sex determination, columbids, morhometrics

INTRODUCTION

Accurate sex identification is an important factor in managing and studying both wild and captive animals. Usually it is not easy to specify the sex of most bird species before maturity, but in monomorphic species, it is difficult even after puberty. Many studies on sex identification in birds was focused on species with significant sexual dimorphism in such factors as size, plumage colouration, or parental ornamentation. (SOUTH AND WRIGHT, 2002). Birds are usually sexed by plumage pattern or morphological differences, gonadal inspection by laparoscopy, and more frequently by chromosome analysis techniques. (GARCELON et al, 1985). Several sexing methods were introduced to ornithology in the past few decades, instead of vent sexing, which is an old method popularized in the 1930s by a Japanese professor, Kiyoshi Masui. Vent sexers could easily get 95% accurate results in sexing. (CERIT AND AVANUS, 2007). However, non-specialist people that learned the basic techniques of this method would be doing well to obtain 60-70% accuracy at best, even though specialists could be wrong in identifications (BRAMWELL, 2003). Since molecular and DNA-based sexual determination has gained popularity, morphometric methods are used as complementary procedures in sex determination. However, molecular methods became simpler; in some cases, morphometric procedures are preferred instead of genetic methods. By adding morphometric factors to the modern DNA-based sexing of adult Chinstrap Penguins (*P. antarctica*) and adult and juvenile Gentoo Penguins (*P. papua)* became easier. Bill length and depth were the most consistent dimorphic character examined, on average male bill records were 5.4–11.5% larger than females. (POLITO ET AL. 2012).

According to HENRY et al. (2015) morphological measurements of a South African sturnid indicated that males were statistically larger than females for four measurements: Mass, tail length, tarsus length and wing length. All individuals involved was previously tested by a DNA-based sexing method. These methods can be used simultaneously during field

and laboratory work. The availability and effectiveness of each methods varies among species. There are species that only a small amount of morphometric data was needed to predict precisely the sex of an individual (MANWHINNEY AND DIAMOND, 1999).

Eurasian Collared Dove is a widespread bird species in Europe. Its range was set from the Middle East to Rear India, where four subspecies were expanded (GLUTZ AND BAUER, 1980; CRAMP, 1985). The expansion began in the early 1920's, the first Hungarian observation set in 1926, in Tiszaug (46.8537215 N, 20.052921 E) (BANKOVICS, 1984), its first nesting was dated in 1932 in Berettyóújfalu (47.2196438 N, 21.5362811 E) (GRESCHIK, 1933). From the 1950's -except in closed forests- the Collared Dove became widespread in Hungary (KEVE-KLEINER, 1944; KEVE, 1950, 1962). The species colonized several part of Western Europe; the expansion of the species was extremely intensive in the European parts of the former Soviet Union (BOZSKO, 1976; HENGEVELD in HAGELMEIJER AND BLAIR, 1997). The reason of this phenomenon still has not finished: in Algeria the Collared Dove had become common in urban habitats in within a few years then reached agricultural lands in 2006 (BENDJOUDI et al., 2015). The breeding population of the Eurasian Collared Dove was estimated 100.000-300.000 individuals at the end of the 20th century in Hungary (MAGYAR et al., 1998). In the case of this species, age and sex determination has several difficulties, since these is no sexual dimorphism in feather pattern. BOZSKO (1983) showed that there is significant difference between males and females in wing length, but this cannot be a precise sexing method, because of the annual molt of feathers. Some monomorphic avian species were successfully sexed by morphometric measurements (SHUGART 1977, REESE AND KADLEC 1982, SKEEL 1982, SCOLARO et al. 1983).Mostly in cases of predators such as eagles individuals were identified using external characteristics (HELANDER, 1981). If the examined species has no sexual dimorphism, behavioral and psychical characters were recorded to identify the sex of an individual. Application of morphometric analyses becomes more complicated especially when the body size and feather colour vary among differing geographical regions (KAHN ET AL., 1998; SHEPHARD ET AL., 2004).

The modern Hungarian game management has set the goal of sustainability; therefore, the management with Eurasian Collared Dove should keep sustainability directives in mind. The first step is to reveal the exact age and sex distribution of populations, to precisely plan the annual bags in hunting sites, and prevent overhunting. This research was made to create the practical basis of the management of Eurasian Collared Doves, by the attempt of creating a quick method of monitoring population parameters that can be used by professional hunters in field conditions.

MATERIAL AND METHOD

Data collection

In August 2018, 18 Eurasian Collared Doves were collected from hunting bags in Nyíregyháza, Hungary. All individuals were identified by age-specific plumage characteristics and set into age classes (juvenile, n=4; adult, n=14). In order to contrast size differences between sexes the following morphometric data was recorded:

Mass (g)
Wing length (mm)
Full body length (mm)

Gap of pubic bones (os pubis) (mm)
After recording the morphometric data, autopsy was performed on specimen to determine its sex and sexual activity.

Statistical evaluation

We searched for connections between age and sex compared to morphometric factors. Independent Samples t-test and Pearson's Correlation Coefficient was used during evaluation. All tests and graphs were made with SPSS 25.0 software.

RESULTS

The independent samples T-test revealed that there are significant differences between age categories in wing length (t= -2.466; p=0.25) and os pubis (t= -4.027; p= 0.01). The correlation coefficient matrix shows that os pubis is positively correlating with the specimen's age, mass, and body length, mass and body length are are closely correlated (*Table 1.*).

Table 1. : Correlation matrix of the measured data

Factors		age	os pubis	mass	body length	wing length
sex	Cor.	-.189	-.298	-.282	-.324	-.445
	Sig. (2-tailed)	.453	.229	.258	.190	.064
	N	18	18	18	18	18
age	Cor.		.709**	.438	.436	.525*
	Sig. (2-tailed)		.001	.069	.071	.025
	N		18	18	18	18
os pubis	Cor.			.599**	.524*	.376
	Sig. (2-tailed)			.009	.026	.124
	N			18	18	18
mass	Cor.				.945**	.284
	Sig. (2-tailed)				.000	.254
	N				18	18
body length	Cor.					.385
	Sig. (2-tailed)					.115
	N					18

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Sex determination

Former researches have failed to determine the sex of Eurasian Collared Doves using morphometric data. We examined the differences of pubic bones in each age categories. The t-test revealed that the gap between pubic bones in juvenile females is shorter (marginal significant difference; p=0.057) than males in the same age category (*Fig. 1.*). In adults, this value becomes balanced due to the overlap in values (*Fig.2.*).

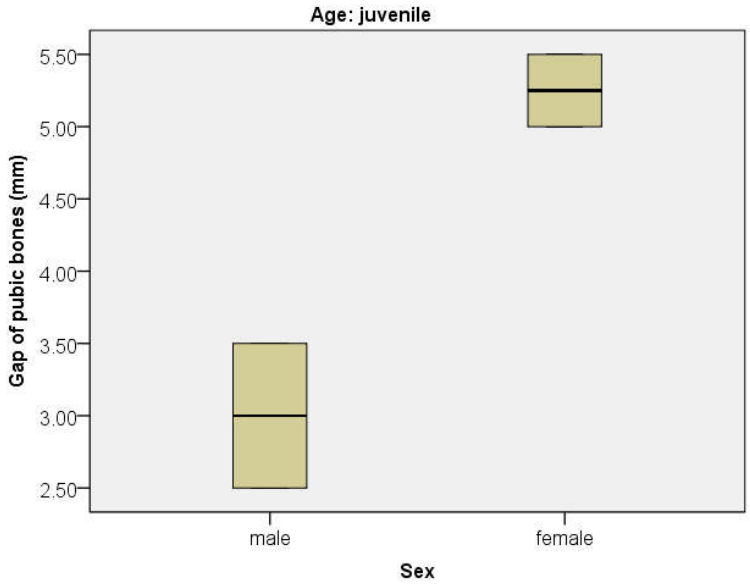

Figure 1. : Gap of pubic bones distribution of among sexes in juvenile age

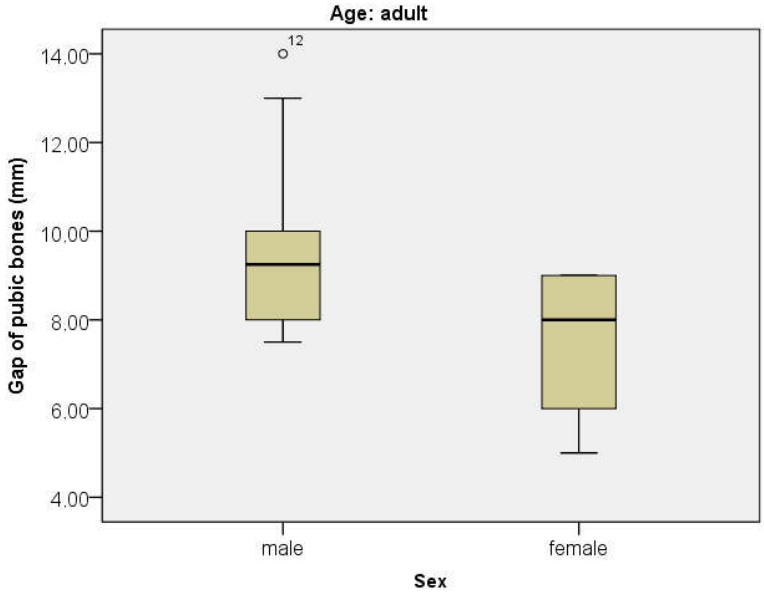

Figure 2. : Gap of pubic bones distribution among sexes in adult age

DISCUSSION

Sexing methods- pros and contras

Morphometric determination has a practical advantage, especially on field. A bird caught by a ringer shall be identified by age and sex immediately. This method is easily repeatable, simple, and safe, and finally yet importantly, no pain is caused during examination. However, classic surgical examination has the advantage of immediate result but a high risk of unwanted consequences, e.g. trauma caused during examination is expressed. In comparison hormonal sex determination has major advantage as it is a noninvasive collection of fecal droppings, no handling of bird are needed, so no stress was caused. The disadvantages of this method is that immature birds has low hormone

production, making this method inapplicable for them. Chromosomal sexing can be applied to birds of any age or condition, if mitotic cells can be isolated and examined. The genetic sex of a bird, irrespective of behavioral or functional characteristics is identified by this method. Genetic sexing technical difficulties are concerned in culturing and isolating complete bird chromosome patterns and lack of available labs working with avian samples. Handling and restraint are necessary in the collection of blood or pin feather samples, which can result in stress and trauma to the bird. The transportation of blood samples to a lab may also be difficult for they must be protected from temperature extremes and begin analysis procedures within 24 hours after collection (BERCOWITZ, 1981). In a research carried out by GARCELON ET AL. (1985) more sexing methods were compared such as morphometric, karyotypic, and laparoscopic techniques on Bald Eagles. All three technique was reviewed and compared to contrast differences is time consumption and effectiveness. By using karyotypic procedure prescribed doses of anesthesia a working time of approximately 30 minutes was provided, with an additional 4 hours required for full recovery. Laparoscopy was performed in approximately 5 minutes, and approximately 20 minutes were required to make all of the measurements. During morphometric data collection, twelve measurements were taken on the birds, and only one showed no overlap in values between the sexes Three additional measurements had little overlap between the outlying extremes of the sexes but none in the 25-75 percentile.

The practical importance of the research

Since Hungarian game management is coping with the problems of decreasing small game populations, wildlife managers seek alternatives to fulfill the demand of hunters. Eurasian Collared Doves are presented in high densities, apart from some regional exceptions; its populations are stable and expanding. Dove hunting is preferred by foreign hunters, because they are fast fliers and hard to shoot. In some regions, they are also served as local gastronomic specialty. The most important economic advantage is that Eurasian Collared Doves need no external input e.g. feeding sites, rural development etc., because they are nesting in human-altered habitats. The only disadvantage appears in summer season, when individuals are leaving towns and cities, causing high damage in agricultural fields, especially in sunflower (*Helianthus annuus*).

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ANALYZING TECHNICAL CHANGES IN BREXIT-RELATED TRADE

MIKLÓS VÁSÁRY

associate professor Budapest Metropolitan University, Faculty of Business, Communication and Tourism, H-1148 Budapest, Nagy Lajos Király str. 9-11., research fellow, University of Szeged, Faculty of Agriculture, H-6800 Hódmezőváráshely, Andrássy str. 15. mvasary@metropolitan.hu

ABSTRACT
The conditions for the United Kingdom's withdrawal from the EU are not yet known at the finishing of this paper. But it can already be known that it will have merit and a significant impact on both parties. At present, this process can be completed in a number of ways, and it is possible to develop more alternatives to exit conditions. At the same time, it is important to see that the transformation of the rule that emerges from the potential of the EU single market, i.e. the abolition of the freely negotiable border raises a number of substantive issues and highlights important problems. In this process, substantial problems will mainly arise in the flow of products. In particular, products that require special attention, for example, are in a special position, e.g. food and agricultural products should be prepared for changes in regulations. It is therefore necessary to collect and describe changes in the physical, technical and administrative rules affecting trade policy changes. The purpose of this study is to summarize the impacts of agri-food commodity flows and to formulate conclusions along these lines.

Keywords: Brexit, international trade, regulations

INTRODUCTION

As everybody know the United Kingdom (UK) had been due to leave the European Union (EU) on 29 March 2019, two years after it started the exit process by invoking Article 50 of the EU's Lisbon Treaty. But the withdrawal agreement (EC, 2019b) reached between the EU and UK has been rejected three times by the fifty-seventh Parliament of the United Kingdom. The EU leaders first time granted an initial extension of the Brexit process until 12 April 2019. After this at the special summit on 10 April EU leaders agreed an extension of Article 50 until the end of October 2019.
Thus, the processes around Brexit have not been completed and solutions have not been reduced to number. But in what framework should the effects of Brexit be interpreted in trade topics.
In terms of the potential economic scenario of Brexit, the fundamental issue is the relationship to the internal market based on the four freedoms after the termination of British membership. If, after legal separation, the UK were (to some extent) part of the internal market, it would not be excluded from the system of European integration in the real economy. The latter is called soft Brexit. While the irreversible abandonment of the internal market is the hard Brexit.

The (hard) Brexit argued - among others - that:

- Eliminate unnecessary regulations. This would place a huge burden on British businesses, which could become more effective;
- Britain could enter into better trade contracts than the EU, and commercial policy conditions for British companies could improve on the world market;
- The British Government would be free to decide who would be allowed to enter and who would reduce social-cultural tensions and lead to more balanced labor market conditions;

- Britain would get rid of the net contributor position of the common budget. (HALMAI, 2018)

What happens to customs when the UK exits the EU? The United Kingdom can reduce its import duties on third countries while, in the absence of negotiated agreements, export duties and non-tariff barriers are increasing. If the United Kingdom enters the WTO system independently, it can reduce the import duties set by the EU Customs Union (Common Customs Tariff). These latter duties are sometimes high. For example, the average duty burden on animal products in the EU is around 20%. In the EU, the average duty rate was 5.3% in 2014, slightly higher than in some developed economies. In the United States, this indicator was 3.5% (IMF 2016). In the WTO system, the United Kingdom either sets a higher MFN duty on imports from 60 countries with a preferential agreement with the EU or has to remove all barriers to all WTO members.

The situation is similar for the EU. If there is no agreement with the EU, UK exports to the EU are subject to EU standard MFN duties. (Unlike the current barrier-free internal market opportunity.) British companies exporting to the EU, and since the UK is no longer a member of the EU Customs Union, face higher administrative costs and higher non-tariff barriers. (With the latter, primarily to the extent that EU product and service standards differ from the UK.)

The big challenge for Brexit scenarios is that the British want a solution that:

- have access, to a certain extent, to the European Union's goods and services market, and in particular to the money and capital markets, and
- to close their labor markets (that is, they may restrict the free movement of persons in a sense).

The above can predict the sensitive points of the precipitation construct. The leaders of the EU Member States and the EU institutions have strongly indicated that the four fundamental freedoms will not be "loose" for Britain during the accession negotiations

The negotiation of a trade agreement with the EU is a complex task. The possible arrangements will vary depending on whether the UK is a member of the European Economic Area (like Norway), to the extent that it completely exits, renouncing all EU rules and regulations. (OECD, 2016) Different options have different effects. There is no consensus among the advocates of Brexit in the preferred layout. The negotiations took even a long time and between the formal exit and the new agreement, the MFN rules apply. The Brexit referendum resulted in a prolonged period of increased uncertainty. Uncertainty and unfavorable outlooks can make investment and economic expectations a long time. All this leads to a reduction in the output dynamics. In important markets - as they adapt to new circumstances - fluctuations may increase. At the same time, the unfavorable scenario can push the British economy into recession.

The effects on British issuance and income are also likely to be negative and significant. Research clearly demonstrates long-term losses (e.g. OECD 2016, IMF 2019). Increased restrictions reduce migration, investment and productivity, resulting in increased trade, foreign direct investment, and increased labor supply. The broad range of estimated losses reflects the assumptions made by the UK on possible future economic relations with the EU and the rest of the world.

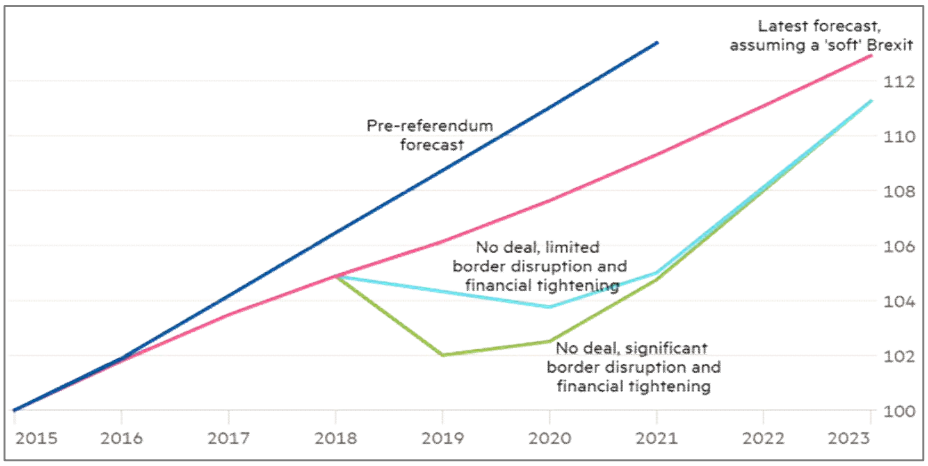

Figure 1.: Forecast that a no del Brexit would lead to recession (UK real GDP, 2015-100): Source:FT 2019

There is considerable uncertainty in the magnitude of these effects. The impact of Brexit is estimated to be between 1% and 10% of UK GDP per capita. The losses of other EU Member States are smaller than this. The uncertain assessment of the effects of Brexit has two main factors. On the one hand, alternative research strategies provide different quantitative results. On the other hand, the potential loss depends on the conditions under which the UK trade with the European Union after Brexit. Disintegration, and the resulting decline in trade, is likely to cost far more than the UK economy to save on a lower contribution to the EU common budget. For the British and European economies, further participation in the internal market would be the best choice. If the UK leaves the internal market, keeping non-tariff barriers at a low level and providing market access to services is crucial for minimizing Brexit costs. It is not just about focusing on customs. Most of the leaks will be perceived by EU Member States. The most affected countires are Ireland, Cyprus, Malta, the Netherlands and Belgium. (EUROSTAT, 2019) These countries and the highly regulated sectors in case of the commercial processes face a challenge. It is worth briefly reviewing the commercial processes and critical regulation elements.

RESULTS

Trade between the UK and other EU Member States is very significant. In this commodity, the 27 Member States collectively achieve a surplus. Bilateral trade is clearly more important for the UK than for its partners. In 2017, bilateral trade accounted for 3.1% of EU GDP and 20.6% of the UK. Moreover, trade between the EU and the United Kingdom increased significantly during the period under review (*Figure* 2.).

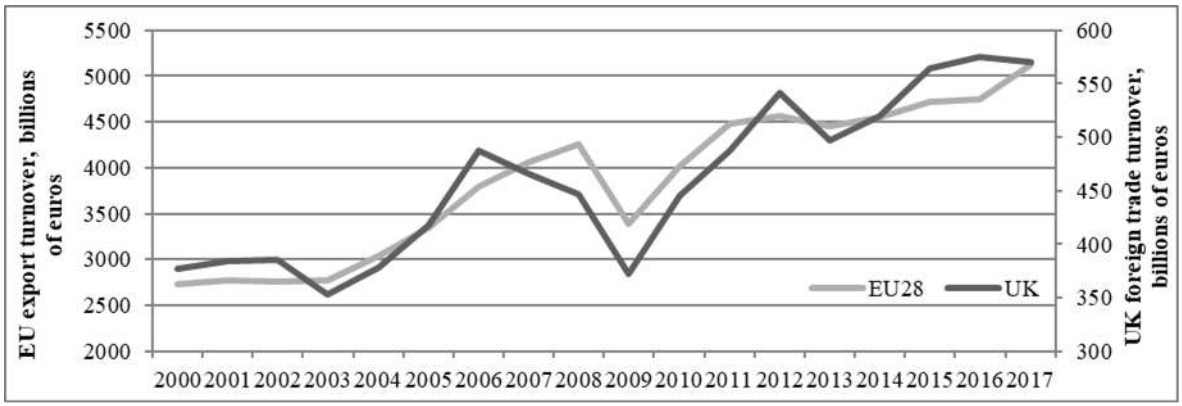

Figure 2.: United Kingdom and EU exports 2000–2017 (billion euros)

Generally, all data used for the analysis was gathered from the freely accessible database of Eurostat (2019). At the same time, exports to the EU showed a declining or stagnating trend after 2000. (*Figure 3*.) Trade with the EU is still of decisive importance for the British economy. However, its share in total British trade has declined somewhat.

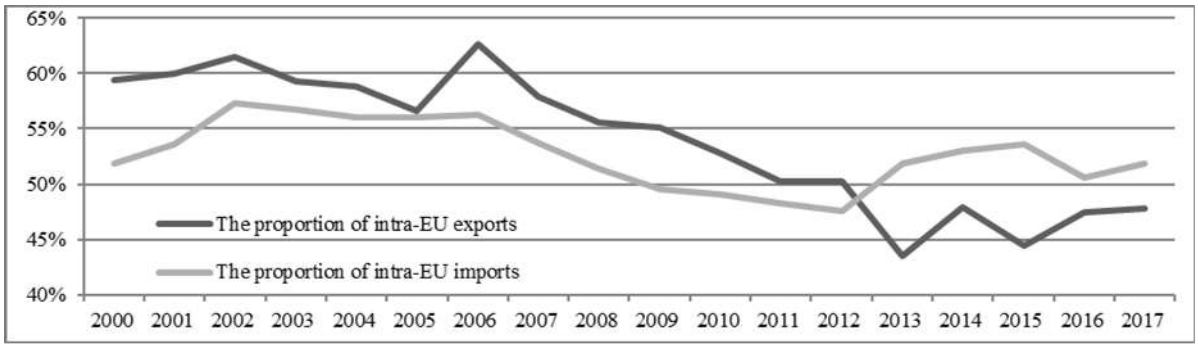

Figure 3: Share of United Kingdom trade within the European Union, %, 2000–2017

In 2000, 59.4% of British exports to the EU (intra-EU). By the end of the period, this ratio decreased to 47.8% as a result of a 19% decline. The reasons for this process should be sought primarily through the strengthening of partners and markets outside the EU. All this is the result of more effective (EU) trade policy agreements, the strengthening of the economies of the former colonies, the effects of exchange rate effects or globalization. In parallel with this process, the share of imports from the second largest importing country in the EU (after Germany and before the Netherlands) also decreased compared to the 2000 base. Looking at the balances of intra-EU trade in EU Member States, the United Kingdom's foreign trade deficit is the largest.

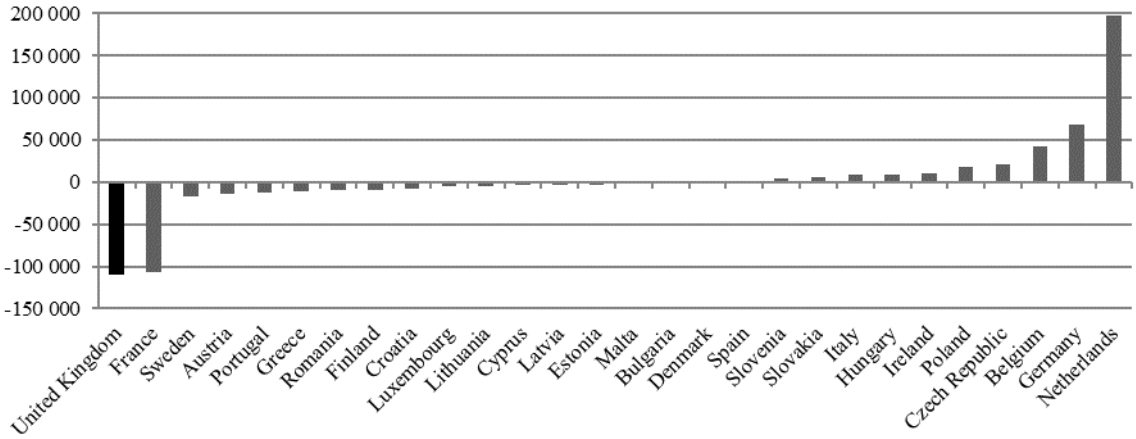

Figure 4. Trade balance within the EU by Member States (2007, EUR million)

EU-UK trade is decisive despite changes in trade processes. Thus, during Brexit, the influencing factors will have a significant impact on the effective execution. Before reviewing the effects, an overview of the expected regulatory areas is needed. Due to the size constraint, only areas for agricultural and food products will be reviewed below.

Animal welfare: The EU has the strongest legislation on animal welfare, including production, transport and slaughter. Five laws provide for the cultivation and production of agricultural animals. The species concerned are laying hens, broiler chickens, slaughter pigs and pigs. Depending on the approach taken by the UK government to food standards, animal welfare rules can be reduced, maintained or increased. Animal welfare rules applicable at international level are less stringent than those applied in the EU.

Plant health: The new rules also make it possible to extend, simplify and harmonize the existing plant passport system. Plant passports are necessary for all movements between professionals but not for sale to final non-professional users. If the United Kingdom is not part of the EEA, the EU and the UK should apply stricter rules in this area.

Plant protection: Access to markets depends mainly on the health status of certain products and the Maximum Residue Limit (MRL) system. In some sectors (cereals and protein crops, industrial plants, fruits and vegetables and ornamental plants), the regulations and their effects are completely different. Since in some sectors the UK is in a net importer position with respect to the EU, the plant health provisions of the import system (and its changes) may have a major impact on market access.

Land resources: If the United Kingdom exits the European Union, the possibilities for UK citizens to acquire land or to use land may vary according to the form of exit: (1) if exit from the EU does not involve exit from the EEA, UK citizens are also considered to be nationals of a Member State in terms of land traffic; (2) if the United Kingdom also exits the EEA, the question is: is there an international treaty under which a British citizen may be treated in this respect with nationals of Member States. (In this context, an existing international treaty may be considered, or a question arises as to whether such an international agreement can be considered as an international treaty in the event of an orderly exit between the European Union and the United Kingdom.)

General food law: Since 2002, the General Food Law Regulation (178/2002 European Parliament and Council Regulation) is the basis for food and feed law. It defines the general principles (i.e. the principle of risk analysis, the responsibility of food business operators, the precautionary principle), the requirements for food and feed safety decision-making (i.e. traceability) and the procedures covering all stages of food and feed production. The provisions cover the entire chain from production to consumer. The legislation provides the basis for food and feed safety, in particular: (1) a high level of protection of human health, (2) protecting consumers against misleading and fraudulent practices, (3) lay the foundations for linking science, (4) ensures effective crisis prevention. The Regulation has established a consistent legal framework for the development of food and feed legislation. The European Food Safety Authority (EFSA) has also set up an independent agency for scientific advice and support. In addition, it established the main procedures and tools for dealing with emergencies and crises, and the Rapid Alert System for Food and Feed. The principles laid down by the Regulation are also supported and implemented by other countries (eg Norway). It is questionable how the UK will implement the principles in the future.

Food labeling: Some EU regulations are an essential element of food labeling legislation. For example, Regulation (EC) No 1169/2011 (the Regulation on food information for consumers) is the general framework or Regulation (EC) No 1924/2006 which regulates the use of health and nutrition claims. Several laws deal with origin labeling. On the one hand, Regulation (EC) No 1169/2011 lays down general provisions, such as voluntary rules on the country of origin. There are also sectoral rules that apply to fresh poultry, sheep and goats and pork. On the other hand, the sector is also affected by vertical regulation on marketing and the quality of certain EU sectors. Honey, fresh fruits and vegetables, unprocessed fish, olive oil, wine, eggs, beef and beef products are subject to specific vertical legislation in this area. The United Kingdom will no longer be obliged to comply with these standards after the withdrawal, unless otherwise agreed.

Labeling of feed: The rules for the marketing of feed materials and compound feed are laid down in Regulation (EC) No 767/2009 on the placing on the market and use of feed in the EU. The feed materials catalog is also an example of coordinating and coordinating the use of names and compliance with different feed ingredients. Key questions: How will the

UK apply feed labeling rules, how it will be able to ensure a harmonized approach, and how it will be able to consider the possible indirect costs of changing labels? The basic question is how the UK will adapt to the new language requirements if the trade flows will change significantly.

Food and feed hygiene: In the area of food and feed hygiene, legislation is also key to guaranteeing European safety standards. Regulation (EC) No 183/2005 on the hygiene of feed and Regulations (EC) No 852/2004, (EC) No 853/2004 and (EC) No 854/2004 concern the hygiene of products and foodstuffs of animal origin. Obligatory registration of food and feed business operators by competent authorities, issues related to specific hygiene practices or specific requirements for certain operations are among the areas covered by this legislation. These rules try to harmonize and simplify hygiene requirements. At the same time, a uniform hygiene standard is applied throughout the food chain for all food market operators. It will be crucial to ensure that these provisions continue to be respected in the UK.

Animal by-products legislation: Regulation (EC) No 1069/2009 and Commission Regulation (EU) No 142/2011 are also an important piece of legislation in the area of food and feed safety, especially as regards animal by-products legislation. Both regulations include risk-based solutions for handling processes, transport, processing, use, and import. it also lays down traceability rules, requirements based on technical standards for animal by-products or enforcement measures. It is questionable how these laws will be applied in the UK in the future.

Official control and enforcement: Harmonized EU rules have been established to prevent, eliminate or reduce risks to humans, animals and plants in the agri-food chain. The purpose of official controls carried out by the competent authorities of the Member States is to check that these rules are properly implemented. Special rules apply to imports. In the EU, the 'Safer Foods Better Training' (BTSF) initiative, which aims to organize the EU education strategy in the areas of food law, feed law, animal health and animal welfare rules and plant health rules, is decisive.

General areas

- The United Kingdom Competition Act (1998) and the Entrepreneurship Act (2002) are based on EU law, so Brexit is not necessarily in immediate competition policy.
- The UK Competition and Market Surveillance Authority will continue to enforce the enforcement of British territorial antitrust procedures.
- Harmonization and cooperation will be needed to regulate major transactions for the EU and UK markets.
- State aid rules under Article 107 of the Treaty will no longer be binding on the United Kingdom in the agri-food industry and in other sectors.
- UK courts will probably not be affected by EU judgments in competition law and public procurement after Brexit.
- The reference for a preliminary ruling to the European Court of Justice by the British courts will no longer be possible after Brexit.
- Due to the new administrative measures, the time required for crossing the border will increase, and the cost of storage will be reduced due to additional storage costs: The European Union, with its common borders with the United Kingdom, should apply its regulations and tariffs to third countries, including the control and control of customs, veterinary and phytosanitary standards, and compliance with EU standards. This would seriously affect transport between the UK and the European Union. Customs, veterinary and phytosanitary controls can cause significant delays, for example in road transport, and in ports.

- Non-tariff barriers can pose as significant or greater a barrier as tariffs to trade in goods (HOUSE OF LORDS, 2017).

CONCLUSIONS

The end of the Brexit is not yet visible, but the more time it takes the more it will be possible to solve technical problems and other details. The more time it takes to get out, the better and more effective solutions can be achieved. It is important to see that concluding a "good" agreement is important and decisive for a party. Commercial rules and regulations are decisive in assessing the effectiveness of exit. Prevention rules, labbeling and other regulations are areas dominated by the EU. The British party will have to adjust to this. Although the UK will have more room for maneuver in defining national rules, the detailed rules laid down by the EU will always be a guideline.

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IMPACT OF BREXIT ON THE TRADE OF HUNGARIAN AGRICULTURAL AND FOOD PRODUCTS

MIKLÓS VÁSÁRY

associate professor Budapest Metropolitan University, Faculty of Business, Communication and Tourism, H-1148 Budapest, Nagy Lajos Király str. 9-11. mvasary @metropolitan.hu,
research fellow, University of Szeged, Faculty of Agriculture, H-6800 Hódmezőváráshely, Andrássy str. 15. mvasary @metropolitan.hu

ABSTRACT
As a result of the longer preparation process, 51.9% of voters voted in the UK on 23 June 2016 in the form of a referendum to leave the European Union. Although the negotiation process has begun, many decisive points and principles - the negotiators' agreement on the post-exit process - have not decided at the beginning of 2019.
The fact that the United Kingdom officially withdraws from the European Union will significantly transform bilateral trade relations. Through the – till now – fruitful cooperation, both sides were able to take advantages and thus have achieved substantial economic benefits, economic and welfare growth. It seems that the UK has been more in need of its trade, so it is becoming increasingly important on what conditions the new cooperation will operate.
But it may also be important to see how the British exit will affect Hungary. Within this framework, one specific area of trade policy, the analysis and evaluation of agri-food processes, should be carried out. Although there is a significant geographical distance between the two countries, there has been a growing and significant commercial activity due to the favorable trade effects.
The purpose of this study is to structure the trade effects between the agri-food industry. In addition, there is a need to organize the affected branches and expected effects too.

Keywords: Brexit, agriculture, international trade

INTRODUCTION

The EU27 is the main link in the UK's agricultural trade. The United Kingdom's share of total intra-EU (i.e. internal market) imports of agri-food accounts for about 10-11%, while the same share for exports is less than 5% on average. (The former was 37 billion in 2017, the latter was 15 billion euro.) The UK accounts for nearly 70% of total agricultural imports from the EU27. The direct agricultural effects of Brexit are most likely to be expected in Germany, the Netherlands, France and Ireland. That is why Brexit means more in the agricultural and food industry than just reducing the risk of market loss. (EUROSTAT, 2018)

One of the most fundamental changes affecting the agricultural economy is in the conditions of sales and entry. In order to expose the problems, a summary overview of the main features of the British agri-food trade and the related trade effects is needed.

The United Kingdom's share of total intra-EU (i.e. internal market) imports of agri-food accounts for about 10-11%, while the same share for exports is less than 5% on average. (In 2017, the former was $ 37 billion, the latter € 15 billion.)

Table 1: United Kingdom and Hungary's share of trade within the EU (2017, Billions of Euros in food, beverages, tobacco) based on Eurostat data

Denomination	export			import		
	Intra-EU28	Extra-EU28	Total	Intra-EU28	Extra-EU28	Total
	Food, beverages, tobacco					
EU-28 billion euro	344,1	121,5	465,6	341,7	112,0	453,7
Hungary – billion euro	6,1	1,2	7,3	4,6	0,3	4,9
United Kingdom - billion euro	15,1	10,1	25,1	37,0	14,9	51,9
Share of Hungary in EU28, %	1,8%	1,0%	1,6%	1,3%	0,3%	1,1%
Share of UK in EU28, %	4,4%	8,3%	5,4%	10,8%	13,3%	11,4%

In 2000, 59.4% of British exports to the EU (intra-EU traffic). By the end of the period, this ratio decreased to 47.8% as a result of a 19% decline. The reasons for this process should be sought primarily through the strengthening of partners and markets outside the EU. All this is the result of more effective (EU) trade policy agreements, the strengthening of the economies of the former colonies, the effects of exchange rate effects or globalization. In parallel with this process, the share of imports from the second largest importing country in the EU (after Germany and before the Netherlands) also decreased compared to the 2000 base. Looking at the balances of intra-EU trade in EU Member States, the United Kingdom's foreign trade deficit is the largest (*Figure 1.*).

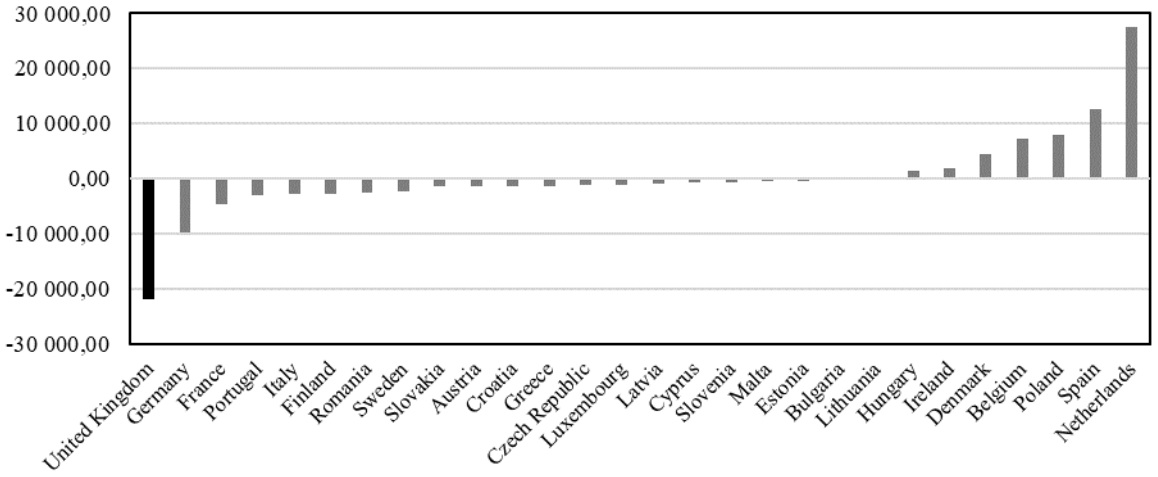

Figure 1: Trade balance of food in the EU Member States (EUR million, 2017) based on Eurostat data

UK imports of agricultural and food products have doubled over the 17 years under review, while exports of this product range have increased by only 50%. A significant part of British foreign trade is processed products or finished products. Quantitative analysis of exports shows that bulk goods, such as cereals, represent the largest batch, but in 2017, drinks jumped to the top. The amount of other processed products is also significant. Similar products appeared in imports, along with fresh goods (meat, milk, vegetables). As the share of these product lines is decisive, countries that move to the UK can also feel the market shrinkage. According to some calculations in Germany, after the contraction of trade volume after Brexit, the production value of pork and poultry may decrease by more

than 2%, and for dairy products by more than 1%. In the British relation, hundreds of millions of euros of traffic may fall. (BANSE ET AL., 2017)

Germany, the Netherlands and France are the UK's largest trading partners in the EU. Consequently, Brexit may be the most affected by these Member States. Bilateral trade of these countries with the United Kingdom accounts for 50% of the total EU27 bilateral exchange. This ranking remains unchanged for exports and imports. Only considering the agri-food trade, France and the Netherlands are the UK's main partners. Ireland will replace Germany in third place. The three major partners account for half of British imports and exports in the agro-food sector. Ireland's trade with the United Kingdom is decisive for Ireland, especially for imports: 27% of Ireland's EU imports come from the UK and 46% of total Irish food imports go to the United Kingdom. (For other European countries, this is 4% on average.) While Irish exports account for 15% of European agricultural food exports to the UK, less than 5% of total Irish food imports.

On the basis of these, the question arises as to what effects can be prepared for Hungary?

MATERIAL AND METHOD

During the presentation of bilateral relations, I used the trade database of the European Union Statistical Office. Prior to presenting the results, the following should be underlined: for country data, the breakdown by sector and product range is based on the trade values available in the SITC (Standard International Trade Classification) and the Harmonized System (HS). (EUROSTAT, 2018)

- Due to the characteristics of the database and the limitations of its size, I analyzed the data from 2000 to 2017.
- For some commodities, the EU should be accepted as a condition for trade in goods between the EU and the EU: values do not, in many cases, indicate that the place of entry or exit in the EU and the final destination are not the same. The statistical register takes into account the place of loading, although many goods are shipped to other countries in the internal market. This unduly overrides the role of some major trading countries.

RESULTS

The value and volume of Hungarian exports to the UK is also higher than that of British imports. In terms of value, the proportion of Hungarian exports is threefold.

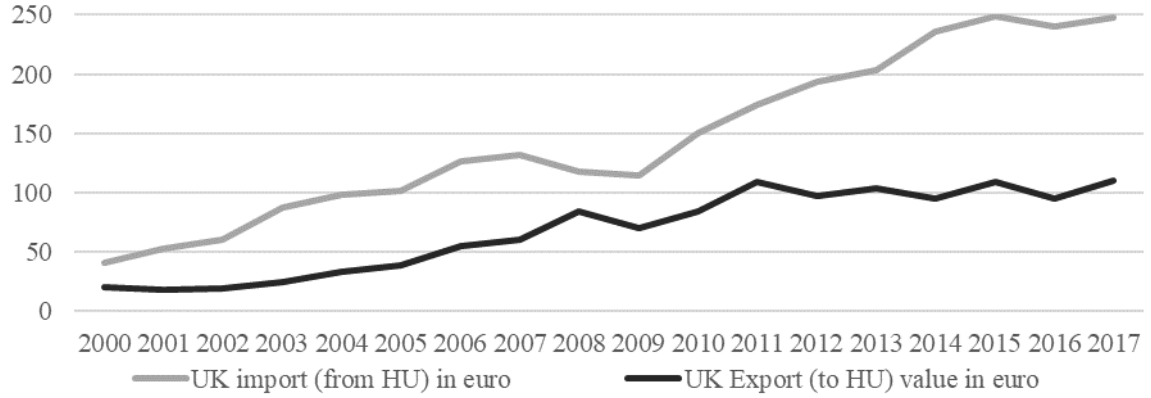

Figure 2: Development of foreign trade in agar and food industry between the United Kingdom and Hungary (2000-2017, EUR million) based on Eurostat data

Table 2 shows the sum of the most important product ranges and Table 3 for all major product groups. Following the specifics of the Hungarian agricultural trade, it is also characteristic of the British relation: from the Hungarian side, the supply of raw materials and semi-finished products, while in the case of island products, mainly finished products, processed materials or high-value animals, animal products were imported.

Table 2.: Ten most important export and import product groups in the agri-food trade between the UK and Hungary (EUR million, 2017) based on Eurostat data

2000				2017			
british import		british export		british import		british export	
Beverages, alcoholic liquids and vinegar	2 093,2	Beverages, alcoholic liquids and vinegar	3 012,0	Beverages, alcoholic liquids and vinegar	7 052,1	Beverages, alcoholic liquids and vinegar	8 671,4
Fish and crustaceans, molluscs and other aquatic invertebrates	1 038,3	Meat and edible offal	2 588,5	Edible fruit and nuts; peel of citrus fruits or melons	5 636,8	Various edible preparations	2 412,5
Products made from cereals, flour, starch or milk; confectionery products	936,3	Edible vegetables and some roots and tubers	1 535,1	Meat and edible offal	4 902,1	Fish and crustaceans, molluscs and other aquatic invertebrates	2 010,3
Meat and edible offal	821,4	Preparations of vegetables, fruit, nuts or other parts of plants	1 446,6	Products of meat, fish or crustaceans, molluscs or other aquatic invertebrates	4 043,4	Products made from cereals, flour, starch or milk; confectionery products	1 906,7
Dairy products; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included	810,1	Dairy products; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included	1 430,2	Edible vegetables and some roots and tubers	3 709,0	Dairy products; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included	1 899,7

An overview of the individual product categories shows that in 2017, 12% of tobacco and processed tobacco products, 3.9% of live animals and 3.7% of alcoholic beverages came from the United Kingdom. (*Table 3*)

Table 3: Proportion of agricultural and food trade between Hungary and the United Kingdom in total EU agricultural trade (EUR million, %, 2017) based on Eurostat data

Denomination	HU-EU28		HU-UK		HU-UK trade in proportion to total traffic	
	import	export	import	export	import	export
Live animals	292.7	344.9	11.5	0.4	3.9%	0.1%
Meat and edible meat offal	533.6	968.2	9.7	18.8	1.8%	1.9%
Fish and crustaceans. molluscs and other aquatic invertebrates	57.9	28.7	0.3	0.8	0.5%	2.7%
Dairy produce; birds' eggs; natural honey; edible products of animal origin. not elsewhere specified or included	436.3	457.0	2.0	6.0	0.5%	1.3%
Products of animal origin. not elsewhere specified or included	51.2	65.5	0.7	0.3	1.4%	0.5%
Live trees and other plants; bulbs. roots and the like; cut flowers and ornamental foliage	104.5	59.1	0.8	1.4	0.7%	2.4%
Edible vegetables and certain roots and tubers	215.9	277.1	2.4	24.6	1.1%	8.9%
Edible fruit and nuts; peel of citrus fruits or melons	268.3	197.6	4.4	1.2	1.6%	0.6%
Coffee. tea. maté and spices	153.2	55.4	3.4	1.9	2.2%	3.4%

Denomination	HU-EU28		HU-UK		HU-UK trade in proportion to total traffic	
	import	export	import	export	import	export
Cereals	165.7	1 539.2	1.1	1.3	0.7%	0.1%
Products of the milling industry; malt; starches; inulin; wheat gluten	61.9	106.1	0.3	0.5	0.6%	0.5%
Oil seeds and oleaginous fruits; miscellaneous grains. seeds and fruit; industrial or medicinal plants; straw and fodder	269.4	633.6	1.7	1.3	0.6%	0.2%
Lac; gums. resins and other vegetable saps and extracts	21.0	0.9	0.6	0.0	2.6%	0.1%
Vegetable plaiting materials; vegetable products not elsewhere specified or included	2.7	4.1	0.0	0.1	0.1%	2.1%
Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes	257.3	552.6	1.4	8.1	0.5%	1.5%
Preparations of meat. of fish or of crustaceans. molluscs or other aquatic invertebrates	255.8	274.0	2.1	35.0	0.8%	12.8%
Sugars and sugar confectionery	190.4	254.7	0.9	9.1	0.5%	3.6%
Cocoa and cocoa preparations	260.8	159.0	0.8	9.3	0.3%	5.8%
Preparations of cereals. flour. starch or milk; pastrycooks' products	366.9	225.1	2.8	9.0	0.8%	4.0%
Preparations of vegetables. fruit. nuts or other parts of plants	224.7	514.3	1.7	23.5	0.8%	4.6%
Miscellaneous edible preparations	473.6	585.0	15.3	37.5	3.2%	6.4%
Beverages. spirits and vinegar	293.9	645.3	10.8	13.2	3.7%	2.0%
Residues and waste from the food industries; prepared animal fodder	443.4	842.4	5.6	38.2	1.3%	4.5%
Tobacco and manufactured tobacco substitutes	243.4	155.4	29.7	6.3	12.2%	4.0%
Total	5 644.4	8 945.1	109.9	247.8	1.9%	2.8%

In imports from the United Kingdom, items with a turnover in excess of EUR 1 million, in the total imports from the EU as a whole, have a high proportion of sun-dried eastern tobacco (95%), poultry-born female grandparents and parent breeding chicks (92%) and \ t tobacco (73%).

For some minor commodities, British imports were 100% in 2017 as a unit fruit jelly (jelly), fruit juice, puree and cream containing dried sugar beet, linoxin or tropical fruit containing more than 13% but not more than 30% by weight of sugar. Among the goods delivered to the EU28 market in the Hungarian exports, the highest British ratio was highest: 12.8% meat products, 8.9% edible vegetables and various edible preparations (e.g. white 6.4% of chocolate and baking powder came to the UK market. 2017. In the case of meat products, with the largest share of British exports, products containing at least 57% by weight of poultry meat or offal (72%), with a significant proportion of white chocolate (84%), baking powder (59%) and candy (50%) also the share of Hungarian exports. In addition, sweet corn, 47% of which is found in the UK, should be highlighted. A high proportion of highly processed products are also linked to the operation of multinational companies, with the characteristics of intra-industry trade.

CONCLUSION

As a result of geographical distance, although it has increased in recent years, bilateral agricultural trade is only modest. Consequently, the direct negative effects of Brexit may be relatively modest for the Hungarian agricultural economy.

Changes in the conditions of British imports for live animals, in particular poultry breeding animals, as well as certain processed foods, alcohols, in particular distillates and whiskey, may lead to a substantial increase in import prices, and possibly a reduction in imports.

In the case of direct Hungarian exports, the biggest problems can be found in the markets for poultry meat products, food products, and processed (frozen and canned) vegetables, especially sweet corn. In addition, the export of wine and feeds, which can be considered essential for Hungarian exports, may become difficult after Brexit.

Considering the intermediary markets, Hungarian agricultural and food industry exports are expected to be significantly more indirectly affected than directly affected. Some of the Hungarian raw materials went to the British market after further processing. Therefore, the purchase and / or price of certain Hungarian agri-export products is likely to be reduced even on the short term by German, Italian, French and Dutch partners.

Due to changing circumstances, the sale of agricultural products that cannot be sold on the UK market would result in a significant additional supply. As a result, competition in the EU27 internal market can increase. Prices would decrease the consequences of competitiveness gaps would intensify. This would also have an impact on Hungarian agri-food operators.

If the current EU rules and regulations in the UK were not fully enforced, British exports would be excluded from the EU27 market. In this case, the export of domestic quality products in the domestic market could expand. At the same time, the acquisition of this market segment is possible only in fierce competition through competitive supply. New markets in Eastern Europe, the Middle East or Asia may also be needed to address market problems at the national and EU level. In doing so, it is essential to organize marketing and information campaigns promoted with national and EU support.

In the medium and long term, hopefully the British trade relations will be able to rebuild and re-export lost export markets.

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THE EFFECT OF DIFFERENT DOSES OF MAGNESIUM TREATMENTS ON THE FENUGREEK (*TRIGONELLA FOENUM-GRAECUM* L.) YIELD

VIKTOR JÓZSEF VOJNICH, JUDIT PETŐ, ANDRÁS PALKOVICS, ATTILA HÜVELY

John von Neumann University
Faculty of Horticulture and Rural Development
Department of Agricultural Sciences
Kecskemét, Mészöly Gyula. Square 1-3. 6000
vojnich.viktor@kvk.uni-neumann.hu

ABSTRACT
Fenugreek (*Trigonella foenum-graecum* L.) is an annual plant belonging to the legumes (*Fabaceae*) family. The plant is a Mediterranean one, native to the Mediterranean coast. It is a multi-use plant that is used as a herb, spice, and fodder plant. Fenugreek has high protein content and is well suited for feeding domestic and wild animals. Our open-field experiment was set up at the beginning of April 2018 in John von Neumann University, Faculty of Horticulture and Rural Development (Kecskemét). The treatments were: treatment 1 = 150 kg/ha, treatment 2 = 300 kg/ha, treatment 3 = 450 kg/ha complex fertilizer. The treatments were carried out in plots of 50-50 m^2. In the experiment, different nutrient supply treatments were set up to achieve the highest fresh biomass weight. The fertilizer used in the research was Novatec premium (15 N - 3 P_2O_5 - 20 K_2O - 2 MgO). When measuring fresh weight of fenugreek, the highest value was measured after 300 kg/ha treatment (14.45 kg). The values of treatment 1 (7.8 kg) and the treatment 3 (8.5 kg) were almost the same. The highest dose of treatment (450 kg/ha) resulted a decrease in the yield of *T. foenum-graecum* in our experiment.

Keywords: fenugreek (*Trigonella foenum-graecum* L.), yield, magnesium treatments, open-field, fertilizer

INTRODUCTION

Trigonella foenum-graecum L. is an annual plant belonging to the *Fabaceae* family of legumes (*Fabales*) (PROVOROV, 1985). Its leaves are like those of alfalfa, the leaves are scattered along the stem (VAN WYK, 2005). The plant is primarily self-pollinating but can also be cross-pollinating (SALVATORE, 1951). The plant is a Mediterranean one native to the Mediterranean coast. In countries of temperate climate, it is grown as a spring-sown plant. It is grown as a winter-sown plant in Egypt, Morocco and India (MAKAI et al., 1996). In Hungary, Sámuel Diószegi and Mihály Fazekas published in the Hungarian Phenomenon in 1807 as a wild herb (MAKAI and MAKAI, 2004). In Hungary before 1945 years, fenugreek was cultivated in the Southern part of the country as a horticultural crop. Later, in 1969-1970, the Agrobotany Institute in Tápiószele started the experimental cultivation. From 1982, research on the technology of cultivating fenugreek and the production of new, intensive varieties began in Mosonmagyaróvár. Then in 1987, a new Hungarian fenugreek variety has been bred, known under the name "Óvári-4". This variety was accepted by the state later, in 1994. It is currently cultivated on 100 hectares in Hungary.
The word *foenum-graecum* means "Greek hay" because the ancient Greeks used the plant to feed animals (MÁTHÉ, 1975). The Egyptians and Romans also called it by this name. Its medical value is also mentioned by Ebers papyrus, B.C. II. Millenium, used as anti-burn medicine (VARGA, 2001). Despite its many healing properties, its effect on humans was not used widespread until the Middle Ages. In modern science, it is only now that its advantages are being discovered. It is primarily used in veterinary medicine. It is mainly used to promote digestion, compress inflammation, fattening, and milk secretion. In North

America, the settlers took fenugreek and used as fodder plant. The *T. foenum-graecum* crop has several advantages. *Rhizobium meliloti* is a nitrogen-binding bacterium on its roots that can bind about 70-90 kg/ha of nitrogen in the soil (MAKAI et al., 1996). Due to its high protein content, fenugreek is well suited for feeding domestic and wild animals.
It is grown for feeding purposes in the following countries: United States, Spain, Algeria, Tunisia, Egypt, Ethiopia, Afghanistan, Iran, India, China (KALMÁR, 1999). It is used as a green manure plant in the USA (California State), Chile and South France. Using as herbal medicine, it is grown in Central Europe. Fenugreek is grown in 2012 on about 96,000 hectares yearly in India.
In our experiment, different fertilization treatments were set to reach the highest volume of green mass and to follow the most advisable treatment dose in these circumstances.

MATERIAL AND METHOD

The experiment was carried out in the study garden of John von Neumann University, Faculty of Horticulture and Rural Development, in Kecskemét in 2018. Our test plant was fenugreek *(Trigonella foenum-graecum L.).* In the course of the open field trials different nutrient doses were applied. Seed sowing was placed in open field on 9th of April 2018. The treatments were carried out in plots of 50-50 m^2, according to the following methods: treatment 1 = 150 kg/ha; treatment 2 = 300 kg/ha; treatment 3 = 450 kg/ha complex ground fertilizer. Mechanical weed control was applied. No chemicals or herbicides were applied. The harvest took place from June 25th to July 9th.
The soil analysis of the experimental area (*Table 1*) and its evaluation was carried out by the Soil and Plant Testing Laboratory of the Faculty of Horticulture and Rural Development (Kecskemét).

Table 1. Soil characteristics of the experimental area (2018)

Denomination	Measurement unit	Value
pH_{KCL}	-	7.61
K_A	-	28
Water soluble salt	m/m%	<0.02
Humus	m/m%	1.43
$CaCO_3$	m/m%	2.62
NO_2-NO_3-N	mg/kg	1.43
P_2O_5	mg/kg	548
K_2O	mg/kg	104
Mg	mg/kg	106
Na	mg/kg	6.61
Cu	mg/kg	13.1
Mn	mg/kg	55
Zn	mg/kg	9.72
Fe	mg/kg	64.1
SO_4	mg/kg	8.4

Fertilizer used in the research was NovaTec premium 15-3-20 (+2MgO+10S) + TE. Technical data of the fertilizer: 15.0% total nitrogen (N); 8.0% ammoniacal nitrogen (NH_4-N); 7.0% nitrate nitrogen (NO_3-N); 0.0% carbamide nitrogen (NH_2-N); 3.0% phosphate (P_2O_5) soluble in neutral ammonium citrate and water; 2.4% phosphate (P_2O_5), water soluble; 20.0% potassium oxide (K_2O), water soluble; 2.0% total magnesium oxide (MgO);

1.6% magnesium oxide (MgO), water soluble; 10.0% total sulphur (S); 8. % sulphur (S), water soluble; 0.02% total boron (B); 0.0% total copper (Cu); 0.06% total iron (Fe); 0.0% total manganese (Mn); 0.01% total zinc (Zn); 0.8% nitrification inhibitor 3.4-dimethyl-pyrazole-phosphate (DMPP) related to total of NH_4-N and NH_2-N; low in chlorine (Cl).
Physical properties: 1, physical appearance: solid, granulated; 2, colour: purple; 3, bulk density: 1,250 ± 100 kg/m^3; 4, granulometry: 90% = 2-4 mm; 5, average granule size (d50): 3.2 ± 0.4 mm; 6, pH (1:10 in water): 4.5-5.5 (URL[1]).
Leaf- and stem samples were dried at 70 °C. The air-dry samples were thoroughly minced. For elemental studies powdered samples were digested in a microwave device by means of concentrated nitric acid and hydrogen peroxide (Milestone Ethos Plus). Main macro element content was measured by optical emission spectrometer (ICP-AES method) (HÜVELY, 2005). Nitrogen content in leaf and stem were determined using the Kjeldahl method after sulphuric acid digestion (FOSS Kjeltec 2300). Macro element (N, P, K, Ca, Mg, Na) contents were calculated in m/m% dry matter.
The required tests were made according to the regulation include measurement of the N, P, K, Ca, Mg content.

RESULTS

Fresh weight and dry weight values of fenugreek are illustrated in *Figure 1*. The highest value (14.45 kg/plot) for the measurement of the fresh weight of *T foenum-graecum* was 300 kg/ha treatments. The 150 kg/ha fertilizer dose (Treatment 1) showed the lowest fresh weight value (7.8 kg/plot). The highest dose of treatment (450 kg/ha) resulted in a decrease in the amount of fenugreek (fresh and dry weight as well). Dry matter content of the plants has also decreased.

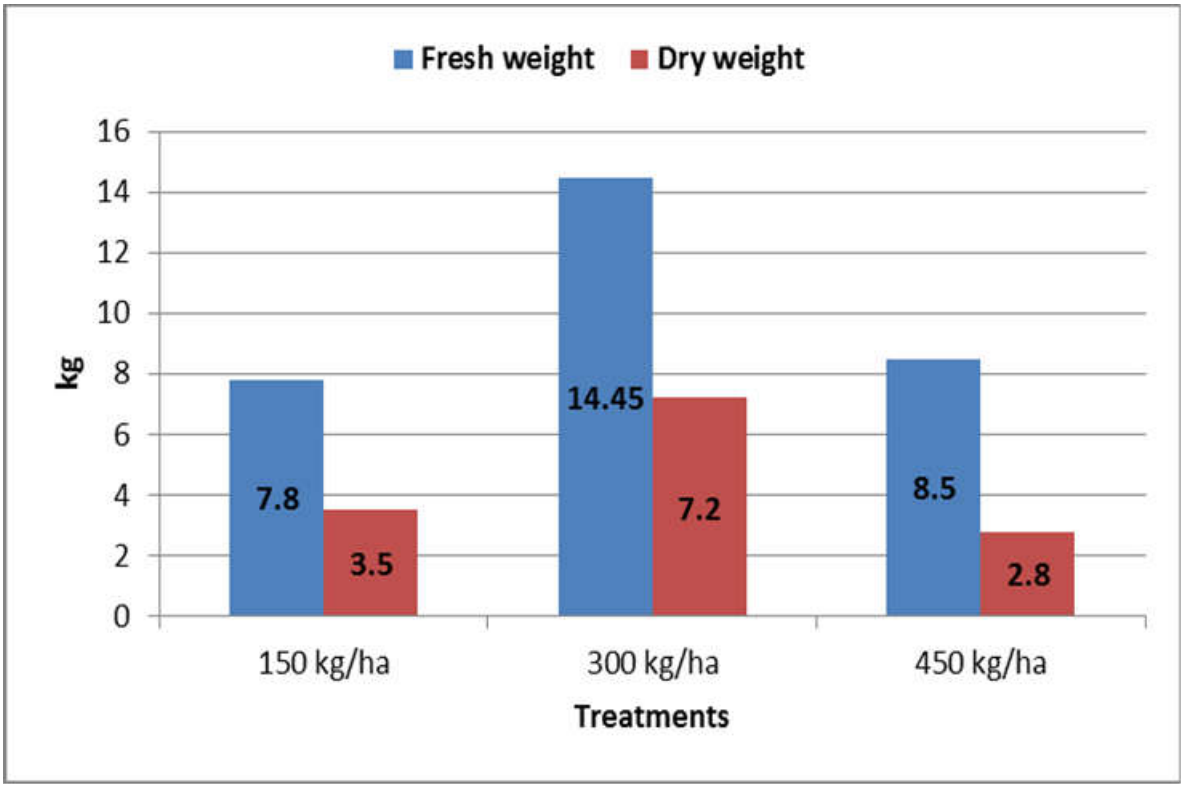

Figure 1. Fresh mass (kg) and dry mass (kg) characteristics of *Trigonella foenum-graecum*

The spring-type *T. foenum-graecum* can be harvested in 80-90 days after seeding (*Figure 2*).

Figure 2. Fenugreek stock on 4th of June 2018

The harvest was at the end of June and early July, when the biomass was recorded (*Figure 3*).

Figure 3. The harvest of fenugreek (3th July 2018)

During the study we determined the concentration of some nutrients (nitrogen, magnesium, calcium, potassium and phosphorus) of fenugreek in the parts of the plants above the ground (stem, leaf) (*Figure 4*).

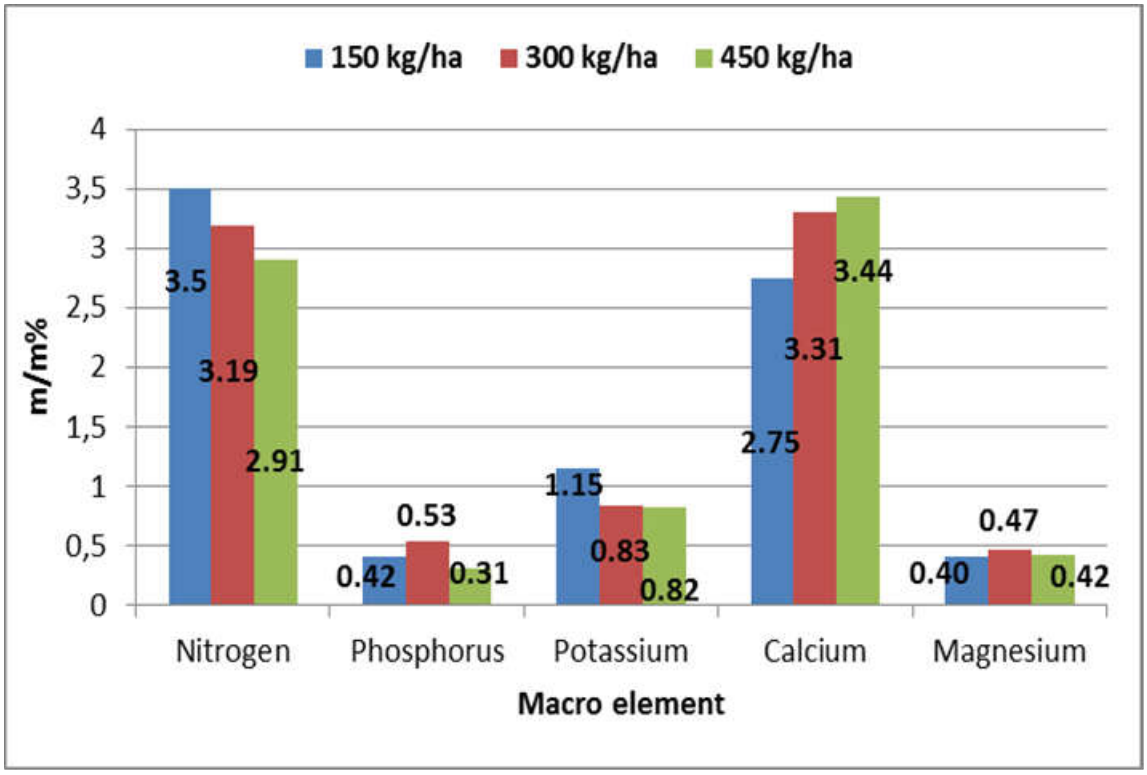

Figure 4. Macro element (N, P, K, Ca, Mg, Na) contents were calculated in m/m% dry matter

CONCLUSIONS

As a result of Treatment 3 (450 kg/ha), the biomass of fenugreek has decreased (wet and dry weight). In order to interpret the effects, we will continue our investigations in the future.
The highest yield of *Trigonella foenum-graecum* was achieved by Treatment 2 (300 kg/ha), both in terms of fresh weight (14.45 kg) and dry weight (7.2 kg).
The content of calcium in dry matter (m/m%) increased linearly from Treatment 1 (150 kg/ha) to Treatment 3 (450 kg/ha) in the examined fenugreek stem and leaf.
In the tested *T. foenum-graecum* plants, nitrogen and potassium contents of air-dry substance (% m/m) decreased steadily by increasing the fertilizer doses from 150 kg/ha to 450 kg/ha.
After the initial growth, phosphorus and magnesium concentration decreased with the increasing fertilizer use. Our results suggest that the highest fertilizer treatment resulted in general lower nutrient levels in *Trigonella foenum-graecum* biomass. In our study, 300 kg/ha fertilizer dose had beneficial effects on biomass production and nutrient contents as well.

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THE IMPORTANCE OF SOCIAL CAPITAL IN AGRICULTURE

TIBOR BENCZE

Szent István University, Doctoral School of Management and Business Administration, Gödöllő, Hungary
bence.tibee@gmail.com

ABSTRACT
The concept of social capital became known in the 1980's as an immaterial resource in the society and it is also a popular area of sociological and economic researches nowadays. Bourdieu, Coleman, and Putnam created the fundamental conceptions of the social capital. Defining social capital as capital involves the philosophy of serving as a resource for the social network.
Studies of the rapidly growing economy of East Asia always emphasize the importance of dense social networks. These networks, the unacceptable, the confidential, reduce the transaction costs, speed up the flow of information and innovation. Social capital and financial capital can be converted. The great economic developments in Hungarians in the last century are different from these causes. In Hungary, there is a very low level of cooperation as well as willingness to develop it. Among Western European countries the level of trust is lower than the average. This basic problem is closely related to the low level of trust and social capital in society as a whole. Partnerships and cooperations are essential nowadays as they can be beneficial to the whole society and economy. In addition, the farmers' eagerness to associate is also weak and the options on how to resolve this issue are still not settled.
Enforcement of the Hungarian peasantry in agricultural cooperatives (1958-1962) left a profound impression on society and its consequences must be taken into account. The good reputation and the credit could be quickly lost; on the contrary recovery – especially rebuild mutual trust- takes more time. Hungarian farmers do not have the confidence to regain each other in the long run. It should be changed, otherwise the majority of the Hungarian farmers will not have the chance to stay competitive.

Keywords: agriculture, economy, social capital

INTRODUCTION

The concept of social funds became known in the 1980s, and as a non-material resource in society, is nowadays a popular area for sociological and economic research. There are many definitions of social funds, but in each of them it is common to interpret social funds in connection with networks. Networks are those separable elements that have some connection between them. So, it is a resource that influences the social and economic processes of communities of different social levels (family, neighbourhood, settlement, micro-region, country). Social funds are slowly recognized as a vital component of economic development worldwide. Research results of rural development students show that an effective network of local associations can be at least as important for growth, as physical investment and the right technology. The role of the family is dual, which can help, but at the same time slows down the development, dynamic development and competitiveness of networks.

I took the views of the three most important experts (Bourdieu, Coleman and Putnam) to clarify the concept of social fund.

According to Pierre Bourdieu, there are three basic forms of fund: economic, cultural and social fund. Social fund is created from social obligations or relationships, which can be converted into economic capital under certain conditions. Bourdieu also says that social

fund is a set of current and potential resources that are linked to a lasting network of relationships that are more or less institutionalized based on mutual acquaintance and recognition. (BOURDIEU, 1998).

James S. Coleman regards social structural resources as the fund of individuals, i.e. social fund. Social fund is determined by Coleman's function. The concept of social fund defines the function of the resource as a resource for the actors of the social structure that they can use to enforce their interests (COLEMAN, 1994).

According to Robert D. Putnam, the concept of social fund refers to social networks and standards of reciprocity, the basic idea being that social networks have value. Accordingly, social networks can be a significant resource for individuals and groups and communities. Social fund is typically composed of bonds, norms and trust that can be transferred from one social environment to another. (PUTMAN, 1993)

The reason for the different interpretations of social fund is explained by the fact that different authors examine the area from a different perspective. Four main approaches are distinguished (WOLZ ET AL., 2004): the area covered, the manifestation, the benefits obtained and the thoughts of the relationship. Several authors also try to define the expression approach. In Stulhofer's work, he depicts the social fund structure as follows (*Figure 1*):

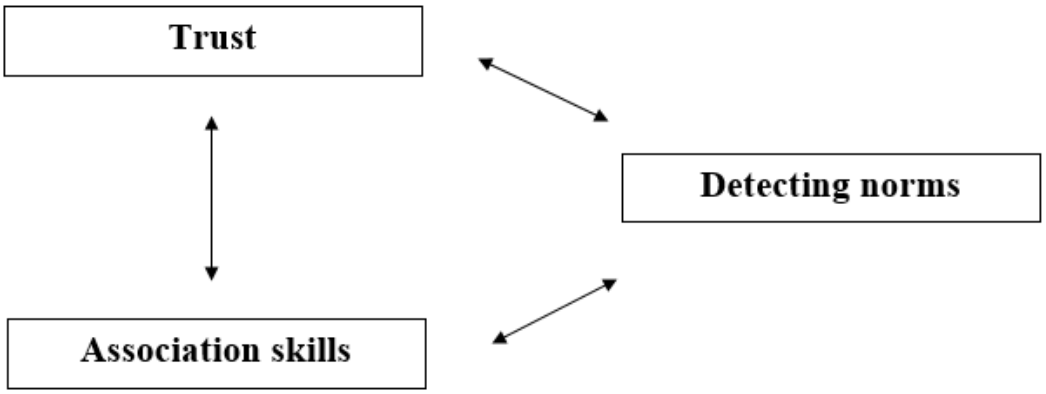

Figure 1.: The structure of social capital
Source: STULHOFER, 2000

The delineation in *Figure 1*. has long been a question which precedes the other. However, the figure lacks an element, and that is honesty. I think this is the first step in strengthening social capital.

Before the examination I had the following hypotheses:
1. The farmers I interviewed have been affiliated with over 50% at some level.
2. Farmers under the age of 40 would be willing to enter the partnership above 50 percent.

MATERIAL AND METHOD

Studies of the rapidly growing economy of East Asia have always emphasized the importance of dense social networks. These networks, which are often made up of a wider family circle or close ethnic community, promote trust, reduce transaction costs, and speed up information flow and innovation. Social fund can therefore be converted into financial fund. China's enormous economic development over the past century can also be attributed to these reasons (VARGA, 1998). This is the central problem of development. If the primary cause of poverty lies in the shortcomings of these three factors, poverty can be mitigated primarily by overcoming these shortcomings. Social fund plays an increasingly important role in the development of developed Western economies. The unexpected decline of free time is a complicating factor, as the members of our generation come into contact with each other to a lesser extent than the market and thus work together less. Families can afford it less, to participate in other social groups other than their workplace, because of the lack of time.

Despite many economic and non-economic benefits, only a small number of producer organizations exist in the Hungarian food industry, their organization and market share are very low, and in general there is a very low level of cooperation and willingness to cooperate in our country. In general, the level of trust in Hungary is lower than the average for Western European countries. The basic problem mentioned above is closely related to the low level of trust and social fund, that characterizes society as a whole. Partnership and co-operation are important nowadays, as its results can benefit the whole society and economy.

In Stulhofer's model, trust, norms and association susceptibility form a closely related, back-and-forth system. There is a low degree of association susceptibility among farmers. Even among the vegetable and fruit producers, the opinion is that "if we have to, then we will be associated". The reason behind this behaviour is a very high level of lack of trust, the causes of which, unfortunately, I can only infer. Farmers are unequivocally common in their processing and commercial vulnerability. Nowadays it is said in many forums that farmers' association susceptibility is weak, but the reasons and especially the ways of solving are hardly mentioned.

In connection with the study of social capital, I contacted hundreds of farmers to get a more accurate picture of the subject. During the research I used a questionnaire method. The results are presented in the next section.

RESULTS

Forcing the Hungarian peasantry into agricultural cooperatives (1958-1962) left such a profound impression on society, that the consequences must be taken into account today. There is truth in it, but only partial truth, because only those older people over the age of 60 remember this experience. The lack of association capacity of younger age groups socialized in producer cooperatives and in different sectors of the public sector is basically not the result of the experiences of the decades between 1960 and 1990. The consequence

of the socio-economic processes that have occurred with the change of regime is the disruption of mutual trust, which forms the basis of social relations.
In connection with the compensation and privatization, the state-owned state and production co-operative property was divided, where a few did much and the majority was little or nothing. The villagers and the inhabitants of small and medium-sized towns know exactly what their human and professional strengths and weaknesses were of their colleagues, acquaintances or relatives. They also know who has enriched it and how it has come to the periphery of society. They saw who and how "privatized" the profitable complementary activities from agricultural large farms. As a result of the above, it has to be said that people have every reason to distrust each other. The basic human trait is that I only associate whom I do not trust when it is absolute necessary, but then I will only commit to it until it is absolutely necessary.

Old Truth: Good reputation and the trust that underlies it can quickly be lost, grounded, and especially recovered for much longer. However, Hungarian farmers do not have a long time to regain their trust in each other. You have to change this, otherwise the vast majority of Hungarian farmers will not have the chance to stay in competition.
I do not necessarily mean a co-operative formation here during the co-operation. In addition to primary cooperatives (cooperative, TÉSZ, BÉSZ), secondary co-operative and integration organizations, which are the same as the previous ones, need to be established for the purpose of ensuring sufficient interest.

The food chain sare also pushing food processors, trying to apply the ancient principle of "the enemy of my enemy", that is, it is appropriate to link strategic processors with food processors.

During my research, I visited hundreds of farmers to gain more insight into the topic. They are interested in their views on partnership and trust between farmers. During the survey, I also met younger and older farmers to take into account the views of both age groups. I set up two age groups: farmers under 40 and over 40. One of my important questions during my investigation is whether they have been associated with other organizations or farmers over the years (*Figure 2.*).

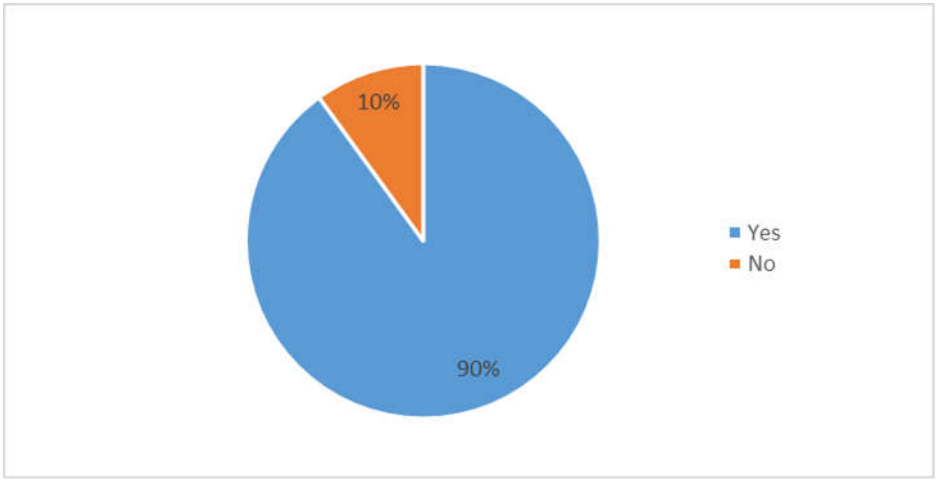

Figure 2.: Collaboration
Source: Based on questionnaire survey, 2019

It can be seen that 90% of the farmers surveyed are already affiliated at some level. I was interested in what kind of problems were the most typical. The most mentioned problems were the distribution of finances and organizational problems. During the organizational problems, everyone wanted to start with their own when using a new technology, which caused problems. 15% of the farmers surveyed are still in some kind of partnership right now.

In the next section I have already split the respondents according to whether they would be associated today.

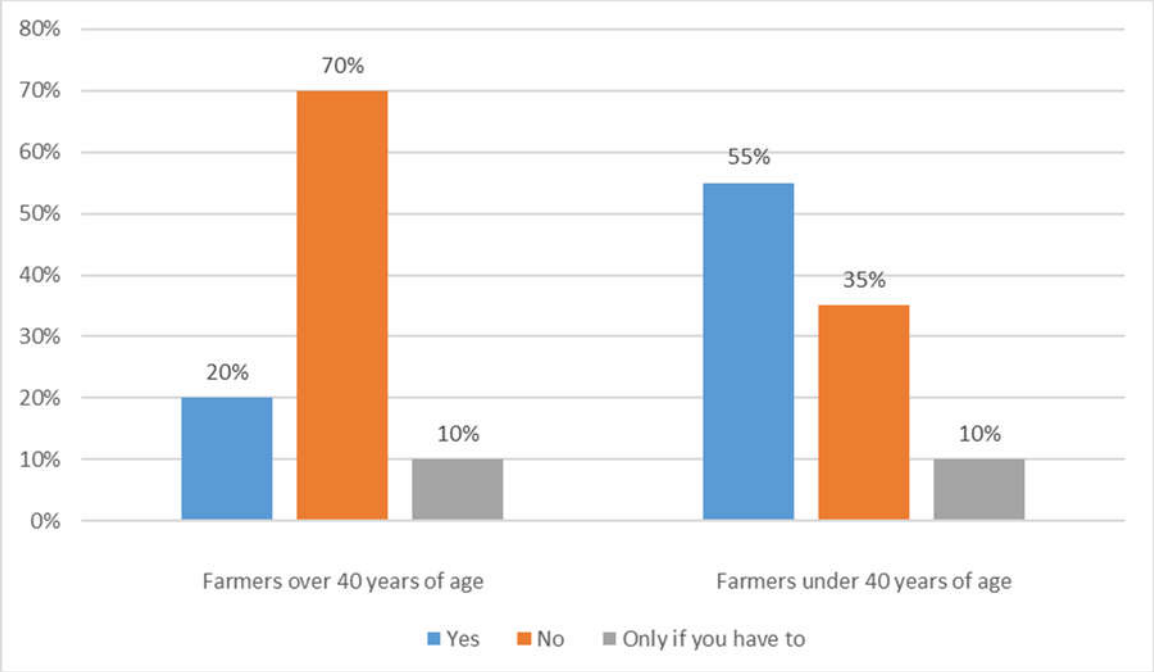

Figure 3. Willingness to cooperate based on questionnaire survey, 2019

The figure shows that 70% of farmers over the age of 40 do not want to become a partner at all. These farmers are likely to have come out of an association with a negative experience and do not want it again. In this age group, the propensity to associate is seen to be low because 20 percent would be willing and 10 percent only if there was no other choice.

In the younger age group, these data developed differently, as can be seen in *Figure 3*. It can be seen that the younger generation would associate much more with the older age group. In my opinion, if they had a partnership experience then it was positive, but they have a fear of association. In my experience, the younger age group is more capable of accepting the compulsion to associate than the older ones. Older people are more afraid of innovations, they think they are fine as they are.
The positive benefits of this cooperation for farmers would be: security of sales, price predictability and improved market bargaining power.
The low level of willingness to cooperate is a barrier to increasing production efficiency and increasing employment.

CONCLUSIONS

The starting point of the development process is that the involvement of communities in the field of rural and economic development should produce results; However, for these skills to really contribute to modernization processes, it is indispensable to consider work as a priority for community development professionals. The knowledge gained from studying foreign and Hungarian literature has drawn my attention to the importance of strengthening social fund. The data available, as well as my own experience, clearly show that this is a crucial factor in the analysis of the future of the rural economy, which has become increasingly important since the nineties, as well. It is a very difficult question how and at what pace we can achieve a positive change in this area, because the characteristic of social capital is that it can be destroyed in a short time, but its construction is usually the result of a long process. Social fund is interpreted in the report of trust, respect for norms and association susceptibility, and I think that the greatest emphasis is currently placed on strengthening this factor in Hungary. Although financial resources play an important role here, it is important to note that with the strengthening of social fund, social costs would be significantly reduced. Strengthening human fund is also indispensable for building social fund. Education has a significant role to play in creating a mentally and morally trained society.

Both of my hypotheses were correct, because 90% of the farmers surveyed were already associated at some level, which is good from this point of view. Unfortunately, the need for association is weak in the 40+ age group, but the 55% is not very strong in the 40s.

Some farmers have realized that they can only be successful, viable in the long term and potentially competitive. The main problem facing the agricultural sectors is that production and processing are separated and this can be changed through cooperation between producers. It is important for farmers to recognize that being a member of a producer partnership is not a risk but a safety issue. In a capital-intensive agriculture, often with sales challenges, cooperation can be the basis for stable profitability.

Hungarian farmers are reluctant to pay for expert advice, and they only try to cooperate, but they basically do not trust anyone, which hinders the more efficient production of Hungarian farmers. Due to a lack of trust, farmers are afraid that if they put that particular amount into development, for example, then the other party will also contribute or use questions about who will use it sooner or what the order will be based on. Taking advantage of technological innovations, the association would be in great need so that together they could more easily buy state-of-the-art technology to produce more and better quality. This process can be seen in the following figure (*Figure 4.*).

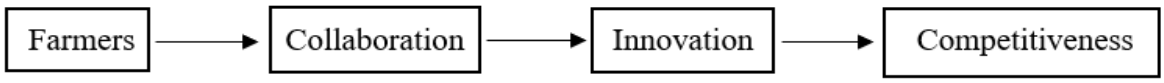

Figure 4. cooperation process

The partnership would also be of great importance to the problem of employment, because farmers could work together to better solve labor shortages. By working together, farmers would receive useful information from each other and, if they sold their crops together, would be in a better bargaining position with buyers or processors, thus improving their sales opportunities. In my opinion, a very, very long-term cooperative can come together, but in Hungary, I still see, where there are so many private owners, that they are frightened by the word cooperative. If they have a positive example, I think they will be more open to cooperation.

The willingness of young farmers to cooperate is stronger because the old bad habits and experiences do not exist. The new generation may also tend to develop long-term partnerships. Young farmers are less distrustful when cooperating with other farmers than older ones, as shown in the *Figure 3*. Young people do not shy away from cooperation if they see new opportunities. Among the difficulties it is worth mentioning the fragmented ownership structure, the exodus from the sector, the aging of the agricultural society and the negative feelings of the cooperative period, which hinder the development of cooperation.

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THE SITUATION OF THE EMPLOYED IN AGRICULTURE

TIBOR BENCZE

Szent István University, Doctoral School of Management and Business Administration, Gödöllő, Hungary
bence.tibee@gmail.com

ABSTRACT
Efficiency improvements result in reduced employment. Regarding the actual individual consumption per capital and the GDP per capita in the EU member states- Hungary is among the lasts. The main reason for this is the weak international competitive role. Competitiveness is one of the prerequisites for efficiency which requires skilled workforce. However, the unemployed from rural regions are generally low-skilled so their employment is not a viable option in the competitive industry or in the agricultural market.
In Hungary, the educational attainment level of agricultural workers is significantly lower than the employment of any other section's or the EU average. Agriculture cannot solve the employment problems of the rural population, it may only contributes modestly to the creation of new workplaces. GDP or gross domestic product is the sum of depreciation, wages and capital income. One of the main reasons of the low GDP per capita is the fact that the wages in Hungary are just a mere fraction of a Western European employee's with the same performance. The share of agriculture has been steadily decreasing in employment and in the production of gross value added, where the average wage of agriculture is significantly lower than the average of the national economy. It also plays a role in lowering the contribution of agriculture to GDP than the proportion of active workers. This explains the higher of a worker's level of education is, the chances they stay in the agriculture permanently is reducing significantly. The social recognition of agricultural activity can only be improved if the agricultural earnings or income of qualified young people reaches the average of the national economy.

Keywords: agriculture, economy, employment

INTRODUCTION

For a decade and a half, the labor market and labor market equalization issues have changed in Hungary. These are the values of employment policy, the labor market and the consideration of social exclusion, the expansion of employment, the conclusion of a missing or weak labor market agreement, the erosion of services, accessibility and social relations (CASTEL, 2005).
The trend in agricultural employment is determined by several factors: higher income in other sectors of the national economy results in an outflow of labor from agriculture. The mobility of the agricultural labor force is also influenced by the age and the level of education. Outside agriculture, employment opportunities are decreasing as farmers age. Education improves the quality of economic governance and the outlook for working outside agriculture (SWINNEN AND DRIES, 2003).

The proliferation of large-scale industrial technology, results in significant labor savings. Increasing efficiency will release additional agricultural labor. The consequence of the employment of younger family members outside agriculture is the concentration process, which leads to a rapid decline in the number of small farms and an increase in the area of the remaining farms (HENKEL, 2004).
The share of agriculture continued to decline in employment and gross value added, while investment fluctuated. In terms of asset value per hectare, gross production value, value added and gross operating income, there is also a significant backlog in the EU. A higher production cost per euro is required than the EU-15 average.

GDP is the gross domestic product of depreciation + wage + capital income (profit, interest, annuity). 65-70% of GDP is already produced by services in the modern economy and not in the narrower sense of material production. One of the main reasons for the low GDP per capita is that the Hungarian wages are from one-fourth to one-fifth of the Western European workers with the same performance.
According to institutional labor statistics, the average gross monthly earnings of full-time employees in agricultural organizations employing at least 5 persons between 2000 and 2010 corresponded to 75-76% of the national average (BIRÓ ET AL., 2012).

Before the research I had the following hypotheses:

1. Less than 70 percent of farmers surveyed have between 1 and 5 permanent employees
2. Over the last 5 years, most farmers surveyed have experienced a drop in labor between 11% and 25%

MATERIAL AND METHOD

Between 4 million and 503 thousand employees, the proportion of men was somewhat higher, but economic growth and job growth seemed to be somewhat favoured the gender imbalance in the labor market.
The level of education among the employees improved further between 2011 and 2016: the proportion of those with no higher education, typically skilled workers, decreased slightly to 26%, and the proportion of high school graduates was still 35%, with a low level of education, for those with tertiary education, 27% increased. In addition to improving the education of the population, the proportion of those with primary education has not decreased over the last five years, due to the increase in employment of low-educated people with the expansion of public employment (KSH, 2016).
The decline in the role of agriculture in rural employment is not an individual case, and even a decade-long trend and a general phenomenon in Hungary. The use and spreading of modern technologies, simplification of the production structure, specialization, and higher incomes in other sectors of the economy and more favourable working conditions have led to the quasi-phasing out of agricultural labor in recent decades.
One of the main characteristics of agriculture is the exposure to weather, natural factors, and the geographical location and accessibility of a given farmer influences the supply and demand situation of the workforce. Due to the high degree of mechanization in arable crop production, large areas of agricultural land are cultivated from sowing to harvesting with low number of employees. There are few extra tasks that are seasonal and require manual labor. In contrast, animal husbandry has fixed tasks (feeding, milking) 365 days a year, no holidays and several shifts works schedules. Supervising the birth / farrowing is a priority. The fruit and vegetable sector have the greatest need for manual labor. The cultivation of propelled, foil or greenhouse vegetables provides employment throughout the year. A critical point in the sector is to cover the high demand for seasonal labor during the harvesting period of certain plant species. All in all, animal husbandry, vegetable and fruit production, and ornamentals are highly demanding among the agricultural sectors. In addition, seasonal work can often mean working hours longer than 8 hours.
Opportunities to increase workforce efficiency or the proliferation of mechanization / robotics are not new. Many economies in Hungary have begun to modernize and have reduced their need for live labor through various precision technologies or other developments.

During my research, I visited 100 farmers to get information on the number and development of their employees. I used the questionnaire method, the results of which will be presented in the next section.

RESULTS

Agricultural employment has clearly shown an upward trend in recent years. According to the data of the HCSO survey on the labor force of the HCSO, the number of people employed in agriculture, forestry and fishing increased by 217 thousand in 2016, by 6.8% in one year and by more than a quarter in the last 6-8 years. Examining a longer time span, 16 years since the millennium, the sector was characterized by a continuous outflow of labor until 2008. However, after the small fluctuations, a substantial increase in the number of people employed in agriculture can be observed on *Table 1*.

Table 1. Number of employed between 1990 and 2017

Year	Number of Employees (Thousands)		
	Total national economy	From this	
		Agriculture, forestry, fishing	Food industry
1990	4 880	693	234
1995	3 679	295	157
2000	3 856	256	154
2005	3 902	194	140
2010	3 732	173	122
2015	4 210	203	140
2016	4 352	217	144
2017	4 421	220	146

Source: KSH, 2019

Examining the composition of the agricultural labor force, according to the data of the Economic Structure Survey 2016, the economic organizations consisted of 94 thousand permanent employees and 55 thousand temporary employees, while the individual farms employed 19 thousand permanent and 71 thousand temporary employees to supplement the work of the family (*Figure 1.*).

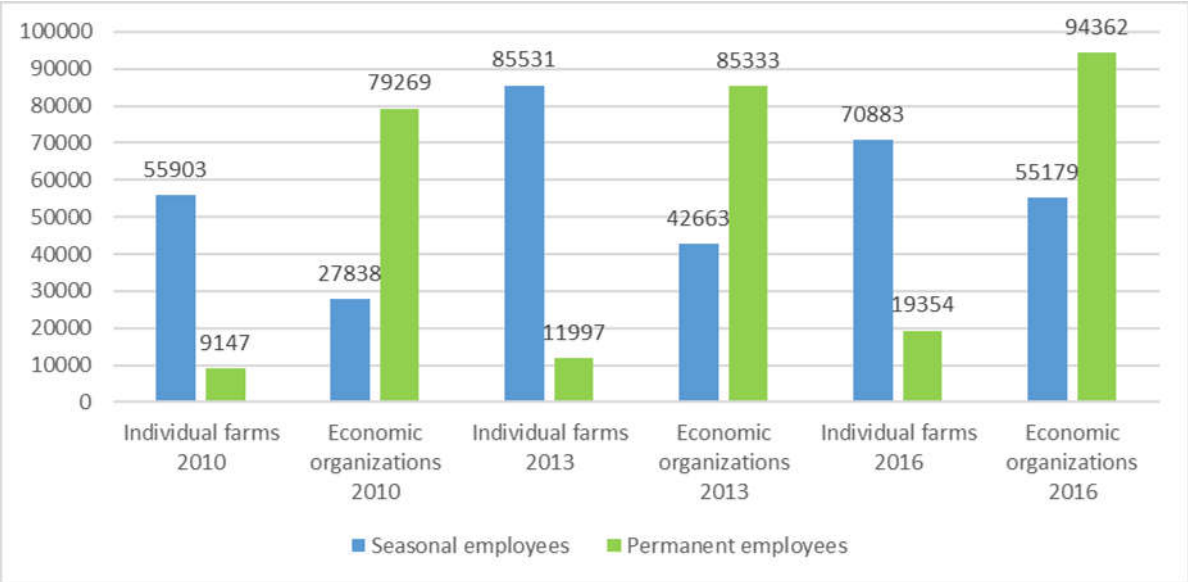

Figure 1.: Permanent and temporary employees by management form
Source: KSH, 2019

Compared to 2010, the number of both temporary and permanent employees has increased in both groups of economy, but growth is particularly noticeable among occasional employees of economic organizations, where their number has doubled in six years and increased by about 27,000. The increase in the number of seasonal workers is due to the change in the legal and tax background of casual employment. LXXV on Simplified Employment 2010 Laws introduced significant simplifications and reductions in seasonal employment, including agricultural seasonal work. These are diminishing public charges and decreasing administration (KSH, 2016).
Unpaid labor utilization accounted for 68 percent of total labor input in 2017, while the rate has gradually declined in recent years, from 75 % in 2010. In parallel, the number of paid workers in agriculture has increased significantly, which may be due to the replacement of declining family labor by paid workers. During my research, I visited 100 farmers to gain more insight into the topic. I am interested in the number of people working in their economy and its development over the last 5 years. I was curious about their views on labor shortages. The *Figure 2.* below shows the number of employees employed by the farmers surveyed.

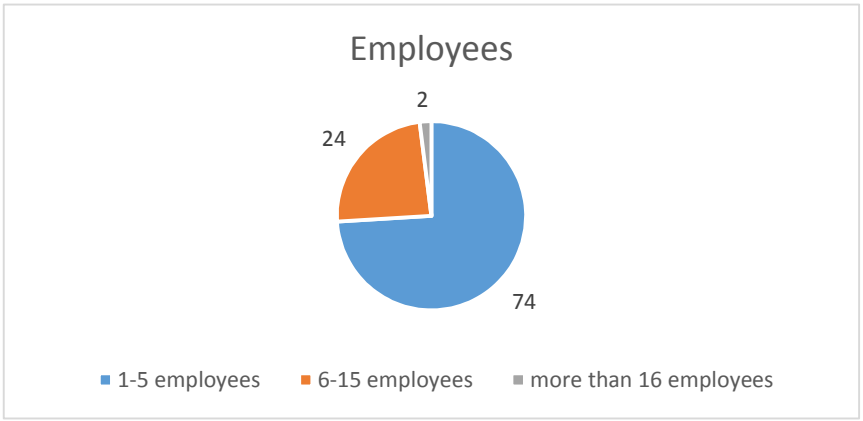

Figure 2.: Number of employees per farm based on questionnaire survey, 2019

The surveyed farmers show that the number of permanent employees is mostly between 1 and 5 persons. These farmers are generally engaged in arable crop production and this is the number of their tractors. 24 farmers reported that the number of employees is between 6 and 15. They are said to be engaged in animal husbandry, vegetable and fruit production, which requires more live work. Two farmers indicated that they employ more than 16 people, have large vineyards and produce large quantities of wine. So, they already need more people due to processing. In the next section, I examined the percentage reduction in the number of employees in *Figure 3.*

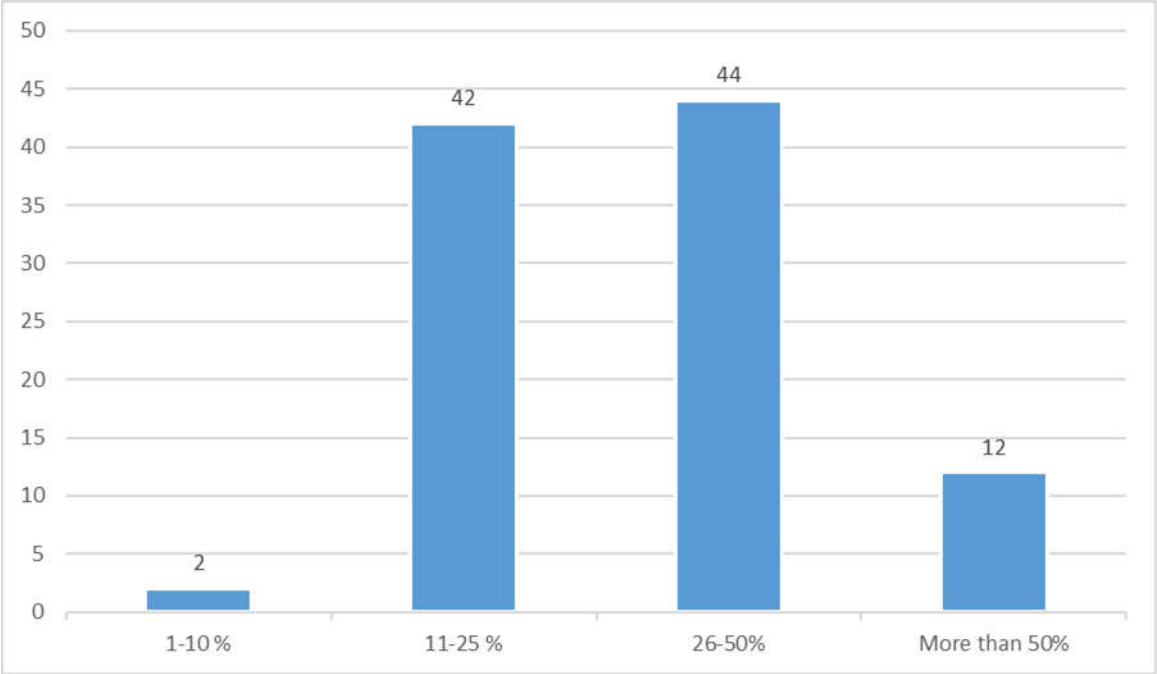

Figure 3.: Decrease in the number of employed in the last 5 years as a percent
Source: Based on questionnaire survey, 2019

The figure shows that for the farmers I interviewed, the workforce decreased the most in the last 5 years by 11-25 and 26-50 percent. Unfortunately, twelve farmers responded that the workforce had fallen by more than 50 %.
During my investigation, I was also interested in what the farmers say may be the reason for the termination. According to them, the problem was not the amount of pay, but rather the long hours at work peaks. The unpredictable working hours and the long working days taken away from family time have led to more family choice and more predictable working time, such as factory work. Mention was also made of moving to a cleaner environment and requiring less physical force. Unfortunately, deaths have also been marked because agriculture is an aging society. According to information from farmers, they say they are trying to pass on their farm to their children and grandchildren, but the lack of labor will be a big problem for them, because agriculture is inconceivable without a living job.

CONCLUSIONS

By the end of my research, none of my hypotheses have been confirmed. 74% of the farmers surveyed have between 1 and 5 employees and 24% have between 6 and 15

employees. In my other hypothesis, which concerned the decrease in the number of employees, the largest number of respondents indicated a decrease between 26 and 50%.

Shaper of job creation, employment is the market on one hand, and state intervention influencing it on the other. Its job is to increase the demand for labor in the long run to achieve the highest possible level of employment, which requires the development of a suitably qualified supply.
In the short term, the goal is to balance the labor market. Neither can the labor market lack social care and solidarity nor help the livelihood of the unemployed without their own fault.
Improvements in efficiency also lead to a fall in employment. Competitiveness is a prerequisite for efficiency and efficiency requires skilled labor, while rural unemployed people are generally low skilled.
In Hungary, the level of education of agricultural workers is significantly lower than that of other branches of the economy and the EU average. Agriculture cannot solve the employment problems of the rural population and may make a modest contribution to the creation of new jobs.
Technological innovations are already present in all branches of agriculture, which require skilled labor. People with higher educational qualifications are less likely to remain permanently in agriculture. Unfortunately, the young and skilled workforce has moved to a city and another sector and there is no indication that they will return to the countryside and find employment in agriculture. The problems that farmers say they have with their employees are: unpredictable and long hours, a cleaner environment. Unfortunately, these problems cannot be solved because the weather generally determines working hours and the environment cannot be changed.

The social moral recognition of agricultural activity will only improve if the agricultural income of qualified young people reaches or is above the national average, but in my opinion, this would require state support.
Improvement of efficiency can be achieved by saving labor input, i.e. by technological development, depreciation is part of GDP. Increasing efficiency and competitiveness can be achieved by improving labor productivity, with profit rising as part of GDP.
Improving efficiency can also be achieved by saving on labor input, i.e. technology development. Increasing efficiency and competitiveness can be achieved by improving labor productivity, with profit rising as well. The output of agriculture could be increased with the help of capital, innovation and expertise, which would increase depreciation, wages and profit.

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EFFECT OF POTASSIUM FERTILIZER TREATMENT ON GROWTH PARAMETERS OF SOME ARCHAEOPHYTE TAXA

Károly Ecseri[1], Péter Honfi[2]

[1]John von Neumann University, Faculty of Horticulture and Rural Development, Kecskemét, Hungary
[2]Szent István University, Faculty of Horticultural Science, Budapest, Hungary
ecseri.karoly@kvk.uni-neumann.hu

ABSTRACT
The aim of our study was to evaluate the effect of fertilization on segetal vegetation, and determine the level of potassium sensitivity in case of three wildflower species.
The investigated model species were: *Cyanus segetum* Hill. (cornflower), *Consolida orientalis* GRAY. (larkspur) and *Papaver rhoeas* L. (poppy). The fertilizer (potassium chloride 60 %) was applied on the 14th of October 2016 (at the same time with sowing). Each plot received 9.375 g, 18.75 g, 37.5 g and 75 g, which is equivalent of 25, 50, 100, 200 kg/ha potassium active ingredient. One plot was 1.5 × 1.5 m. During the trial we did not applied any form of agro- or phytotechnical method, the plants were extensively maintained. The examination method based on horizontal and vertical plant parameters, on phenological stages comparison.
The spring development (growth of rosette) began at 800°C in the case of *Cyanus segetum* and *Papaver rhoeas*, while the overwintered seedlings of *Consolida orientalis* developed after a heat sum of 900-1100°C. Due to autumn sowing, the vegetation period started in 2017 10-14 days earlier than in the 2016 experiment, when the sowing date was in February.
Nutrient application increased the height of plant, but did not affect the width and length of the plants. The positive effect were detectable in all treatments (*Papaver rhoeas*); or just 100 kg / ha treatment (*Cyanus segetum* and *Consolida orientalis*). Treatment accelerated the growth of *Consolida orientalis* plants. Positive effect of treatment was observed in terms of germination percentages and overwintering of poppy plants.

Keywords: cornflower, larkspur, poppy, vegetative development, heat sum

INTRODUCTION

Large amount of potassium is present on the surface of clay minerals, but is only slightly accessible (HORINKA, 2010). Natural potassium replacement (buffering ability of soil) occurs through ion exchange on the surface of clay minerals and depends on the amount and composition of clay minerals. Soils with low clay content and sandy texture have a higher soil solution concentration, lower potassium content and weaker buffer capacity (LOCH ET AL. 2006). It plays an important role in the development of fruit quality parameters (HORINKA, 2010). Moreover, it also enhances frost tolerance, because of lower freezing point in the cellular fluid, for example in the case of overgrown herbaceous plants. It also has a proven effect on pathogen resistance, as it enhances stalk strength through the reinforcement of cell walls and reduces damage to aphid species (PETHŐ, 2002; HARGITAI, 2005; LOCH ET AL. 2006).
Deficiency of potassium causes yellowing from the top of the leaves. The small, necrotizing patches appear only in the tissues between the leaf veins (HARGITAI, 2005). Overdose - due to ion antagonism - results generally relative deficiency of other cations (HODOSSI et al. 2004). Deficiency of potassium reduces the abiotic stress tolerance: it increases sensitivity to high light intensity (easy to form chlorotic and necrotic patches on the leaf) and cold; drought and salt stress sensitivity (CAKMAK, 2005). Potassium treatment

under drought stress increased photosynthetic activity and the amount of carbon stored in the roots in case of some legume species (SNAGAKKARA et al. 2000).

MATERIAL AND METHOD

The experiment was carried out in 2016-17 at the Presentation Garden of the Faculty of Horticulture and Rural Development of John von Neumann University (46 ° 55 '10' N, 19 ° 41 '13' E). The soil is sand based, constantly cultivated, weed free. The marking of plots and plowing to 20 cm deep was on 19 September 2016. Even, aerated, small particle size sowing bed was made after plowing. Then, on October 14, 2016, we planted 15 plots. Cornflower and larkspur seeds were incorporated 1-2 cm deep, poppy seeds were scattered on the surface. Sowing was not irrigated due to adequate soil moisture, the weather forecast predicted ample precipitation. During the trial we did not applied any form of agro- or phytotechnical method, the plants were extensively maintained.
Seeds quantities sown:

- *Cyanus segetum:* 0,4 g (approx. 200 seeds)
- *Consolida orientalis*: 0,5 g (approx. 400 seeds)
- *Papaver rhoeas* (formula mixture): 0,04 g (approx. 400 seeds)

Plant species in the same treatment were put in one plot, there was a 20 cm walkway between treatments. The marking of plots were made with a 50 m tape measure, the edges were marked with 50 cm wooden sticks. One plot was 1,5 × 1,5 m. The fertilizer (potassium chloride 60 %) was applied on the 14th of October 2016 (at the same time with sowing) on the 12 plots. Each plot received 9,375 g, 18,75 g, 37,5 g and 75 g, which is equivalent of 25, 50, 100, 200 kg/ha potassium active ingredient.
Examination method based on phenological observations (measurement of horizontal dimensions of seedlings before flowering - May 15, 2017, and height measurement in the middle of flowering - 22-23 June 2017).
The statistical assessments were made by using singlefactorial analyses of variance (ANOVA) and multifactor correlation tests. Significant difference was determined by Tukey's test (α=0,05). For assaying, we used SPSS 20 program (IBM, New York, US).

RESULTS

Cyanus segetum

The germination of seeds was nearly 100% based on plant number determination. Just in case of 200 kg/ha treatment was significantly less (149 plants developed about 200 seeds). Rapid spring development was observed on the plots when vegetative stages were compared. Most of the plants were still in 2-3 leaf stage on March 24, but the shoots started to grow on March 31, and 9 well-developed leaves were formed on April 6th. Then followed a continuous shoot elongation on 2nd-3th decade of April. At least 9 well-separated internodes were formed at the beginning of May, on each plot and the first flower buds appeared. Side shoots also developed until first decade of May (3-7 pieces per plant). The beginning of flowering was on May 15th in every plot. The top of flowering was in the last days of May and in the first decade of June. At the same time, the development of achenes was started in the capitulum. The ripening and colouring of the fruits was observed from mid-June. The number of capitulum has decreased since then,

and the withering of stocks was detected since the last days of June. The end of flowering was on July 25th, when the dying plots were eliminated.
In the statistical analysis there was no detectable difference in the width and length of the plants (SL <α, in both cases). When comparing highness data, the Tukey test showed significant difference between the control and the 100 and 200 kg / ha fertilizer dose plots where the plant height was the highest. There was no significant difference between the plots in the duration of flowering, although the top of flowering in the control area started 5 days before the treated parcels and ended sooner, but there was no difference at the beginning and end of flowering.

Consolida orientalis

The percentage of germination was lower than *Cyanus segetum*. Only 117-157 plants developed from the approx. 400 seed at the end of the experiment. Two leaved larkspur seedlings were overwintered and started to develop in March. Nine leaves stages was reached at the first decade of April (50, 100 and 200 kg/ha treatments) and at the end of April (25 kg/ha potassium and control plots). The shoot elongation began similar to cornflower: the first well separable internodes were found one week later in the control and 25 kg/ha potassium treated plots. At least 9 internodes were formed until the beginning of May, in every 5 plots and the first buds appeared. Side shoot also developed until middle of May, numbering 1-5 per plant. Analizing this side shoots, significant difference was found. The plants of control and 25 kg/ha treated parcels were less branching, than plants in 50 kg/ha parcel (*Table 1*). This difference can also detect in the length and intensity of flowering.

Table 1. Pairwise comparison of *Consolida orientalis* side shoots depending on potassium fertilizer application

	Treatment	Subset	
		1	2
Tukey HSD[a,b]	25 kg/ha	22.79	
	Control	22.93	
	200 kg/ha	23.00	23.00
	100 kg/ha	23.14	23.14
	50 kg/ha		24.00
	Sig.	0.878	0.074

The flowering began in the second decade of May; the top of decoration period was on May 24-26. This time began the development of follicles. The blooming time was finished in the second decade of June, and the ripening and colouring of the fruit happened in the second half of June. Then the stocks die rapidly and completely withered on 30 June. Variance analysis did not show significant differences between treatments (SL <α for both parameters), for the analysis of width and length data. The pairwise comparison of the highness data, it can be concluded that plants on the plots treated with 50 and 100 kg/ha are higher than the control plot. The smallest and highest dose treatments caused not higher

plants than the control (*Table 2*). There was no significant difference in the generative development, although the end of flowering was on the control plot 3-6 days earlier.

Table 2. Pairwise comparison of *Consolida orientalis* highness depending on potassium fertilizer application

	Treatment	Subset		
		1	2	3
Tukey HSD[a,b,c]	Control	89.55		
	200 kg/ha	94.90	94.90	
	25 kg/ha	100.90	100.90	
	100 kg/ha		118.35	118.35
	50 kg/ha			143.65
	Sig.	0.762	0.113	0.072

Papaver rhoeas

There were significant differences in the number of germinated seedlings. Only 20% (72 plants) of the sown seed (about 400 pieces) were found on the control plot, while the number of plants was higher in the treated plots (105-139). The poppy plants had 1 leaf in every parcel on March 24, but the 9 leaf rosette form was reached already one week later and remained in this phase until the last decade of April. The shoot elongation was observed in the first half of May. The maximum internode number was between 6 and 9 per plant. The side shoots were observed from mid-May, numbering from 1 to 9 per plant. The first buds were developed in the first days of May, but only at the end of the month began the blooming period. The generative phase was wavy with flowering tops and breaks. The growth of fruits also began in the last days of May, and their final size was reached mid-June. The colourisation and ripening of fruits occurred at the end of June. Stocks were completely died until the first days of July.
No difference was found in the length data ($F = 1.585$, $SL = 0.185 > \alpha$). Only the width of the 25 kg/ha treated plants was lower than on the 200 kg/ha treated plants ($F = 3.262$, $SL = 0.015 < \alpha$). The analysis showed also significant difference in case of highness ($F = 11.856$, $SL < 0.001$). Based on pairwise comparison, the lowest individuals developed on the control plot. There were only differences between the smallest and the highest fertilizer application. Flowering period started 7 days earlier in the control plot, but there was no difference between the treated and control plots when examining the further development of the generative phase.

CONCLUSION

The treatments had no effect on the horizontal dimensions of the plants. At the same time, difference could be detected between the highness of control and treated plots, in the case of all three species. The difference is primarily due to the stimulating effect of potassium, which caused the elongation of flowering stems. It is interesting to note that the plants of *Cyanus segetum* and *Consolida orientalis*, were higher than the plants treated with nitrogen fertilizer treatment in the 2016 vegetation. This may also have the effect of different sowing times. The spring development (growth of rosette) began at 800°C in the case of

Cyanus segetum and *Papaver rhoeas*, while the overwintered seedlings of *Consolida orientalis* developed after a heat sum of 900-1100°C. The shoot elongation and the leaf number increase began at the same time in the case of cornflowers (after reaching 800°C), while at least 1200°C heat sum was required for the flowering stem elongation of poppy. The vertical growth of larkspur started after reaching a heat sum of 900-1100°C. The flower bud appearance and the shoot elongation began at the same time in the case of poppy, while in case of larkspur and cornflower there were 1-2 weeks between these two stages. The flowering period of three examined species began, when the heat sum reached 1450-1600°C. The top of flowering was 1500-1650°C in case of *Consolida orientalis*; 1650-1800°C in case of *Papaver rhoeas*; and 1750-1850°C heat sum in the case of *Cyanus segetum*. Based on these data, it can be concluded that larkspur needs higher temperatures for vegetative development than the other two species. The rosettes of poppy needed more than a month to start of flowering stems elongation.

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FACTORS INFLUENCING INTERNATIONAL BEER TRADE

LILI JANTYIK, ÁRON TÖRÖK, ATTILA JÁMBOR

Corvinus University of Budapest
Department of Agricultural Economics and Rural Development
1093 Budapest Fővám tér 8.
lili.jantyik@uni-corvinus.hu

ABSTRACT
Beer has been presenting in human life for a long time. The oldest written proof of beer production, the "Monument Bleu", comes from Mesopotamia, the 3rd millennium BC and by this time brewing was regulated by law (Ulischberger, 1982). Nowadays, globalization liberates the markets and large brewing companies achieve tremendous growth. In 2016, trade value of beer made from malt was 13,8 billion USD, according to the UNComtrade (2019) data. The main exporter was Mexico with 27% share in total beer export, followed by three EU beer producers: Netherlands, Belgium and Germany with shares of 14%, 11% and 9%, respectively. On the other side, beer import was even more concentrated: the USA represented 35% of global beer import, followed by France and the United Kingdom (5-5%), China (4.5%) and Italy (4.3%). In case of beer, domestic consumption largely determines the industry, because the largest producers are not the top exporters. Based on FAO (2019) data, in 2014, 28% of global beer production was brewed in China, followed by the USA (the biggest importer - 13%), and 8% was produced in Brazil. Germany and Mexico, the two main exporters, only had 5-5% of market shares in terms of global beer production.
In our study we measured competitiveness using the index of Symmetric Revealed Comparative Advantage (SRCA), calculated for all countries exporting beer in the period of 1988-2017. In order to identify factors influencing SRCA, we applied panel-data linear models by using feasible generalized least squares (FGLS). We used the following independent variables for the model: barley production, FDI (foreign direct investment) levels, population, per capita GDP, per capita beer consumption, beer export unit value, number of beers with geographical indications, EU membership (as a dummy variable) and beer production.

Keywords: beer, international trade, geographical indications

INTRODUCTION

Beer is one of the most commonly consumed alcoholic drink in the world and the beer industry is a relatively frequently researched topic. KARAGIANNIS ET AL., (2018) investigated the industry in Europe. They found that a significant part of the estimated markup is due to product differentiation, especially in Bavaria. Moreover, the profit margin was higher for large firms and increased over time. They also observed increasing returns to scale and average costs above marginal costs, so in the German brewing sector a high markup does not necessarily translate into a high profit margin. In the study of DREYER AND FEDOSEEVA (2016) and DREYER ET AL. (2017), they also investigated the German market. They examined when the German beer exporters apply the Pricing to Market (PTM) strategies. The exporters apply PTM for local-currency stabilization, on those markets where imports are very sensitive to exchange-rate changes. German beer exports are strongly dependent on policy variables such as the introduction of Euro and the partner country's membership in the EU. Fertő and Podruzsik (2016) examined the pattern and driving forces of Intra-industry Trade (IIT) in beer market using relative factor endowments and the integrated Helpman and Krugman model. The results showed a negative relationship between differences in capital–labour ratios and IIT, and also between impacts of distance and IIT. The outcomes also confirmed the increasing role of IIT for beer products within the enlarged EU. The estimations supporting the dominance of vertical- over horizontal-type trade. On Member States' level, Austria, France, Germany, Italy and the UK report the highest levels of IIT within the enlarged EU. Olper et al.,

(2012) also examined the beer industry in the European Union. With theory-driven gravity equation they found that the home bias in beer consumption is higher than in wine. The home bias in beer is widely attributable to the home market effect, which means the breweries are localized close to their consumers in order to minimize the high transport costs associated with beer exports. ZANOTTI ET AL., (2018) examined the relationship between competitiveness and operational and financial performance of firms in the European brewing industry. Their results show that the competitive construct of the industry is significantly related to the financial performance of companies, but not inevitably to the operational results, and the operational structure of the company does not necessarily provide significant relationship to the financial results of the enterprise. In a British study the beer consumption data and the estimated new price and cross price elasticities for on- and off-trade beer sales reflect falling overall beer sales and also the changing dynamic within the British market. The estimated price elasticities had additional consequences, especially the efficiency of UK customs and excise duties for on-trade draught beer and the imposition of a minimum price per unit of alcohol. According to the results, in order to increase tax revenue, additional duties on beer are likely to be contradictory as long-term beer demand is price elastic. (TOMLINSON AND BRANSTON, 2013)

Several beer trade related studies exist which examine the Trade Agreement between the USA and Canada. Econometric analysis shows that it has a large impact on many American agricultural export categories: almost all the consumer-oriented products (except wine and beer), five of the intermediate products, and four of the bulk products. According to the same study, American affiliate sales in Canada have stimulated American exports of consumer-oriented products and intermediate products (MUNIRATHINAM ET AL., (1998). MALONE AND LUSK (2018b) used a branded discrete choice experiment for beer. They found that perceptions substantially affect consumer choices. In the context of brand equity for beer brands, the perceived taste and brand familiarity were key determinants of choice. In the article of MALONE AND LUSK (2018a) they collected data in the United States to identify potential market segments through consumers' taste perceptions of various beer brands. Besides several marketing research methods they used cluster analysis to provide a description of how market segments are influenced by brand familiarity.

THOMÉ AND SOARES (2016) used very similar approach as in this paper. They also examined the international competitiveness and market structure with Revealed Comparative Advantage, Relative Position of Market, Hirschman-Herfindahl index and Net Export Index for the period of 2003–2012. Their results show a high concentration for both the import and export markets and the detainers of the largest shares are: the United States of America for imports and Mexico, the Netherlands, Belgium and Germany for exports. The actors in the market structure could be identified on the basis of exporters, importers and exporters by stressing their market position.

MATERIAL AND METHOD

In order to measure comparative advantages on international level, we calculated the Symmetric Revealed Comparative Advantage (SRCA) for all the countries trading with beer between 1988 and 2017. SRCA is a linear transformation of the Balassa index (B),

$$B_{ij} = \left(\frac{X_{ij}}{X_{it}}\right) \Big/ \left(\frac{X_{nj}}{X_{nt}}\right), \quad (1)$$

where *x* means export, *i* indicates a given country, *j* is for a given product, *t* stands for a group of products and *n* for a group of countries. It follows that revealed comparative advantage or disadvantage index of exports to reference countries can be calculated by

comparing a given country's export share from its total export - in correlation with the focus country's export share in their total export.

$$SRCA = (B-1)/(B+1) \quad (2)$$

To identify the factors influencing competitiveness of beer trade, we also run panel regression model with variables explained in Table 1.

$$SRCA = \alpha + \beta_1 logBarleyprod_{ij} + \beta_2 FDI_{ij} + \beta_3 logPop_{ij} + \beta_4 logGdppc_{ij} + \beta_5 logBeerprod_{ij} + \beta_6 eumember_{ij} + \beta_7 gibeer_{ij} + \beta_8 pccon_{ij} + \beta_9 tuv_{ij} + \varepsilon_{ij} \quad (3)$$

Table 1 Variables included to the panel regression calculations

Variable	Remark	Source
SRCA	dependent variable, normalized RCA index	own composition based on World Bank data
logBarleyprod	logarithm of the barley production	FAOSTAT
FDI	FDI income measured in current USD	World Bank
logPop	logarithm of the population	World Bank
logGdppc	logarithm of the GDP/capita	World Bank
logBeerprod	logarithm of the beer production	FAOSTAT
eumember	dummy variable, =1 if the given country was the member of the European Union in the given year	European Commission
gibeer	number of beers with geographical indications in the DOOR database in the given year	European Commission
pccon	per capita beer consumption	World Health Organization
tuv	unit value of the beer export	FAOSTAT

RESULTS

The TOP10 countries based on their SRCA index of beer production are indicated in *Table 2.*

Table 2 TOP10 countries with highest SRCA index for beer trade

Country	average SRCA 1988-2017
Namibia	0.93
Jamaica	0.84
Mexico	0.72
Netherlands	0.66
Denmark	0.62
Serbia	0.60
Dominican Republic	0.59
Ireland	0.53
Croatia	0.49
Belgium	0.44

Results of panel regression are summarized in Table 3. In general we can say that all the variables are statistically significant (mostly with $p<0.01$).

Table 3 Results of the panel regression model

	SRCA
logBarleyprod	-0.010
	(1.67)*
FDI	0.000
	(2.61)***
logPop	-0.151
	(7.92)***
logGdppc	-0.159
	(8.45)***
logBeerprod	0.118
	(6.87)***
eumember	0.284
	(8.84)***
gibeer	0.024
	(2.23)**
pccon	0.053
	(4.77)***
tuv	-0.077
	(3.22)***
_cons	2.077
	(7.69)***
N	1.536

* p<0.1; ** p<0.05; *** p<0.01

CONCLUSION

Revealed comparative advantages measured by SRCA seems to be high for all the most important exporting countries except Germany. Mexico and Netherlands were among the countries with the highest SRCA values indicating strong comparative advantages (0.72 and 0.66 respectively, calculated as an average of the period 1988-2017). However, the most relevant importers (except the United Kingdom) had comparative disadvantages in international beer trade.

The panel regression model also provided solid, statistically significant results (mostly with p<0.01). Barley production had very marginal and negative effect on SRCA index, so the input can be purchased from international markets. FDI did not have a direct impact on competitiveness. The population and the purchasing power (GDP/capita) of the domestic market had a negative influence on beer competitiveness. It seems producers with higher per capita consumption were usually more successful in exporting. The EU membership also increased SRCA level. We also examined the role of the quality in the beer industry. Producing and exporting beer with geographical indications had positive influence on the exporting countries' comparative advantages. Export unit value is in negative correlation with competitiveness, so we can conclude that large quantities of average quality beers more relevant in competitiveness. We found that quantity of beer production strongly and positively influenced SRCA. Countries producing more beer can expect more success in the global market.

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IDENTIFICATION OF THE FACTORS INFLUENCING THE PROFITABILITY OF THE HUNGARIAN BEER INDUSTRY

LILI JANTYIK, ÁRON TÖRÖK, JEREMIÁS MÁTÉ BALOGH

Corvinus University of Budapest
Department of Agricultural Economics and Rural Development
1093 Budapest Fővám tér 8.
lili.jantyik@uni-corvinus.hu

ABSTRACT
Beer consumption and beer industry is an important beverage sector in Hungary because the beer is the most consumed alcoholic beverage in the country according to WHO studies. During history, breweries developed in different size and different values. The Hungarian beer industry can be divided into three groups of breweries: old large scale breweries, old microbreweries and new wave microbreweries. In this paper, we examine the factors influencing the economic performance of the Hungarian beer industry based on panel data of all active Hungarian breweries in 2018 (121 breweries), for the period of 2009-2017. The study applied panel-data linear models by using feasible generalized least squares with error structure with no cross-sectional correlation option. The economic performance is measured by companies' turnover, EBIT and profit, which were used as dependent variables. The following explanatory variables were applied in the model: age of brewery (number of closed business years), Social Media activity (FB likes of company page), geographical location (distance from Budapest in km), direct sales (represent own pub/direct sales channel), impact of tax reduction (small beer companies pay 50% less tax since 2012). Regression results have shown a number of determinants of the economic performance of Hungarian breweries, and the estimations are valid for all profitability indicators included (turnover, EBIT and profit). As in previous research, we have come to the conclusion that if the company survives the early years of operation, we can expect profitable activity. Since the ratio of early bankruptcy among Hungarian brewers is still very high, the fluctuation between smaller breweries strongly determines the industry.The benefits of short food supply chains (both physical distance and number of intermediaries) are also prevalent in the beer industry. Breweries with direct sales channels (mostly their own pubs) showed significantly higher sales, EBIT and profits compared to those selling their products by third parties. Breweries situated in Budapest are the most profitable, because the capital city provides a higher demand for high-quality beer, in contrast, the distance from the capital city has a negative impact on the firm's success.The Social Media activity, often used as the only promotion channel for the microbreweries, has a positive impact on the brewery's profitability. Finally, tax reduction for small breweries introduced in 2012 by the Hungarian government had the most important positive impact on industrial profitability, especially in the case of microbreweries. It seems the government aim to support small scale beer production has been successful because it helped the survival of the Hungarian microbreweries.

Keywords: Hungarian breweries, profitability, short food supply chains

INTRODUCTION

The microbreweries appeared all over the world in the past years and although their market share is relatively small they are constantly growing. That's why many research focus on the development and reorganization of the beer markets. The craft beer revolution is a phenomenon which started in the United States. From 1978 the Federal Law allows the home production of beer at national level. The research of MCCULLOUGH ET AL. (2019) examines the relationship between homebrewing legislation and the growth of the beer industry across the United States, and finds that enacted legislation has had a significant effect on the structure and growth of the brewing industry. GARAVAGLIA AND SWINNEN (2018) analysed the economic perspectives of the craft beer inside the global beer industry. Their book takes a look at the situation of the craft beer market in different countries.

There are other country-specific studies which analyse the craft beer industry from different aspects. Among others, FASTIGI et. al. (2018) investigated this topic in Italy. They were focusing on a special group of agricultural breweries. The basic requirements for a microbrewery to be considered as an agricultural one is that more than half of the cereals used in its beer production must come from the brewery's own cultivation. In their studies agricultural breweries are themselves "revolutionising" the sector with their larger size, business orientation, creation of local supply chains, and also their realistic attitude towards the real evolutionary potential of the sector may represent a real opportunity for the longer-term success of the Italian craft brewing industry. In another Italian research, they examined the knowledge transfer in a start-up craft brewery. Authors found that the entrepreneur played a fundamental and crucial role in the start-up process, acting as a selective and passionate broker for the knowledge transfer process (CARDONI ET AL. 2019).
The econometric analyses of the Hungarian researchers show that the size of the company has no linear effect on the chances of survival of microbreweries, while other company-specific feature, such as export, the age of the company does not affect the likelihood of survival. Among the characteristics of the industry, the level of growth, concentration, and intensity of entry play a role in the survival chances of small-scale breweries. (FERTŐ ET AL. 2016)
KOCH AND SAUERBRONN (2019) examined the consumption of craft beer in Brazil. In the study, they found that "Drink less, drink better" is the main slogan of the Brazilian craft beer consumers. They show commitment to enjoyment and responsibility while reject mass-produced beer and antisocial behaviours, which usually associated with beer drinkers. So for the craft beer drinkers, the beer means much more than the mass-beer consumers. RIVAROLI ET AL. (2019) also examined the motivation and the attitude of the craft beer consumption on German and Italian sample. Their conclusion is that social norms and self-identity are both directly influences the consumers' behaviour to drink craft beers, so we can say this beverage is in the era of the "experiences economy", where goods and services sold are no longer just physical products.

MATERIAL AND METHOD

In our research, we attempt to identify the factors influencing the profitability of the Hungarian (micro)breweries. We have analysed all the active players of the Hungarian beer industry, using the financial data of the companies available in the M&A Research Catalyst database (2018), for the period of 2009-2017.
The profitability was measured on three levels, we used dependent variables for turnover, EBIT and profit. The detailed explanation of the data included in the model is summarized in Table 1.

We applied panel-data linear models by using feasible generalized least squares (FGLS) with error structure with no cross-sectional correlation option:

$$lnturn/lnEBIT/lnProfit = \alpha + \beta 1FBlike_{ij} + \beta_2 OwnPub_{ij} + \beta_3 lnDistanceBP_{ij} + \beta_4 BreweryAge_{ij} + \beta_5 TaxReduction_{ij} + \varepsilon_{ij}$$

Table 1 Variables included to the panel regression calculations

Variable	Remark	Source
lnturn	dependent variable, the logarithm of the brewery's turnover	M&A Research Catalyst
lnEBIT	dependent variable, the logarithm of the brewery's EBIT	M&A Research Catalyst
lnProfit	dependent variable, the logarithm of the brewery's Profit	M&A Research Catalyst
FBlike	number of likes of the brewery's Facebook profile	own data collection
OwnPub	dummy variable, =1 if the brewery has it's own pub	own data collection
lnDistanceBP	the distance of the brewery headquarters from Budapest, km	own data collection
BreweryAge	the number of closed business year	M&A Research Catalyst
TaxReduction	dummy variable, =1 if in the given year a reduced tax applied for microbreweries	own data collection

RESULTS

Results are summarized in *Table 2*.

Table 2 Results of the panel regression model

	(1)	(2)	(3)
VARIABLES	lnturn	lnEBIT	lnProfit
FBlike	2.36e-07***	2.16e-07***	2.48e-07***
	(7.58e-09)	(2.13e-08)	(2.29e-08)
OwnPub	0.259***	0.229*	0.201*
	(0.0817)	(0.133)	(0.121)
lnDistanceBP	-0.0588	-0.0837	-0.0776
	(0.0358)	(0.0529)	(0.0528)
BreweryAge	0.0791***	0.0348***	0.0199***
	(0.00475)	(0.00748)	(0.00675)
TaxReduction	0.498***	0.204	0.566***
	(0.0870)	(0.182)	(0.214)
Constant	9.298***	8.398***	7.963***
	(0.185)	(0.280)	(0.262)
Observations	559	353	346

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The Social Media activity, often used as the only promotion channel for the microbreweries, has a positive impact on the brewery's profitability and turnover. The benefits of short food supply chains (both physical distance and number of intermediaries)

are also prevalent in the beer industry. Breweries with direct sales channels (mostly their own pubs) shown significantly higher sales, EBIT and profits compared to those selling their products by third parties. Breweries situated in Budapest are the most profitable, because the capital city provides higher demand for high-quality beer, in contrast, the distance from the capital city has a negative impact on the firm's success, however, these results are not statistically significant. Like in previous research (FERTŐ ET AL. 2016), we have come to the conclusion that if the company survives the early years of operation, we can expect profitable activity. Since the ratio of early bankruptcy among Hungarian brewers is still very high, the fluctuation between smaller breweries strongly determines the industry. Finally, tax reduction for small breweries introduced in 2012 by the Hungarian government had the most important positive impact on industrial profitability, especially in the case of microbreweries. It seems the government aim to support small scale beer production has been successful because it has significantly contributed to the profitability of the Hungarian microbreweries.

CONCLUSIONS

Breweries can be found all over the world, and beer is a major beverage for consumption in almost all countries in the world. Beer is the most consumed alcoholic drink in Hungary. The paper examined the factors influencing the economic performance of the Hungarian beer industry based on panel data of 121 active Hungarian breweries in 2018 for the period of 2009-2017. We applied panel-data linear models by using feasible generalized least squares estimations in order to measure the performance of the industry. The breweries' economic performance is measured by companies' turnover, EBIT and profit as dependent variables. The age of brewery, Social Media activity, geographical location, direct sales, and impact of tax reduction was applied as explanatory variables in the model. The descriptive statistics confirm a low economic performance of Hungarian brewing industry. Regression results have justified the selected determinants of the economic performance for Hungarian breweries, and the estimations were valid for all profitability indicators included. Result suggests the benefits of short food supply chains (geographical distance and number of intermediaries) are also prevalent in the beer industry. Breweries with direct sales channels (such as own pubs shown significantly higher sales, EBIT and profits compared to those selling their beer products by marketing channels. Breweries situated in Budapest are the most profitable, since the capital city provides a higher demand for high-quality beer, by contrast, the distance from the capital city has a negative impact on the company's performance. The Social Media activity (FB likes) has a positive impact on the industrial and micro brewery's profitability and turnover. Finally, tax reduction for small breweries introduced in 2012 by the Hungarian government had the most significant positive impact on industrial profitability. In conclusion, the government aim to support small scale beer production has been successful because it helped the survival of the small scale Hungarian microbreweries.

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POSSIBLE ROUTES OF THE CHINESE NEW SILK ROAD - CAN THE V4 COUNTRIES BENEFIT?

ZALÁN MÁRK MARÓ – ATTILA JÁMBOR – ÁRON TÖRÖK

Corvinus University of Budapest
Department of Agricultural Economics and Rural Development
1093 Budapest Fővám tér 8.
zalan.maro@uni-corvinus.hu

ABSTRACT
The Ancient Silk Road was created 2100 years ago during the Han Dynasty (I-II century BC) to promote trade between China and Europe. The road was more than 7,000 km long and served as a catalyst for development for many centuries. After the 15th century, the Silk Road – and, at the same time, China's dominant role – lost its significance due to geographical discoveries. The dramatic fall in technology and the cost of transportation has led to the Silk Road being forgotten today.
The New Silk Road Initiative (also named 'One Belt, One Road' concept) has been China's greatest economic effort ever, with the main objective of stimulating economic development in Asia, Europe and Africa. It consists of two parts: the Belt will rely on major cities along the route that will carry some kind of central economic and commercial functions; while the Road is based on large ports, which together will result in a safe and efficient logistics route.The concept would affect 64% of the world's population (4.4 billion people) and would cover 30% of the world's GDP ($ 21 trillion). In recent years, China's economic growth has slowed down, and Chinese goods have become more and more expensive to rely on their main competitive advantage, the low price. This trend points to the need to examine the possibilities of making the transport of goods more efficient. Asia-Europe rail trade accounts for between 3% and 3.5% of total trade between the continents. It follows that 95-96% of the trade between the two continents is carried out at sea. The exact routes of the New Silk Road Initiative have not yet been fully defined but will consist of several land and sea transport routes. We made a systematic literature review to identify the possible paths of the New Silk Road. The initial search obtained 1.739 entries across all databases, which ended up in 49 relevant publications, but in this study we used only 17 publications due to the specificity of the topicAccording to the majority of the literature, the New Silk Road would consist of three general land routes. The first land route from China to Central Asia and Russia would reach Europe through the Baltic Sea. The second route would run through Central-, West Asia, the Persian Gulf to the Mediterranean and Central Europe. This route would affect the V4 countries, especially Hungary. The third route would run through Southeast and South Asia to the Indian Ocean. The Maritime Silk Road would start from the coasts of China through the South China Sea and the Indian Ocean to Africa and Europe; as well as from the Chinese coastal ports through the South China Sea to the Pacific Ocean.

Keywords: New Silk Road, trade routes, V4

INTRODUCTION

The Ancient Silk Road, which was created 2100 years ago at the time of the Han Dynasty (I-II century BC), was a more than 7,000 km long road between Asia, Europa, and Africa. Despite its name, it was not just a single road, and besides silk - which was not a luxury product at that time - spices, silver, porcelain and other goods were also transported.

The road helped the flow of goods, culture, art, history and religion for many centuries between China and Europe. After the 15th century, the dramatic fall in technology and the cost of transportation have led to the Silk Road being forgotten until recently. In the first decades of the 21st century, the construction of a new Silk Road was once again on China's economic and political agenda. The new Silk Road intends to re-establish a link between Europe and Asia based on railway lines and the historic Silk Road (CASARINI, 2016; YU, 2017). At first, the return to the railroad seems to be a huge leap forward, but modern supply chains depend to a large extent on the trade of intermediate goods. Air freight transport guarantees faster, just-in-time (JIT) delivery, however, the weight and size of the

goods are important factors in the use of air and rail transport. In addition, intercontinental railways have made significant progress in reducing the time and cost of international transport in recent times (LI AND SCHMERER, 2017).

China's economy, and hence its economic growth, is driven by a strong export-oriented manufacturing industry, while China is importing large amounts of intermediate components and raw materials to its manufacturing industry (YU, 2017). In recent years, China's economic growth has slowed down, and Chinese goods have become increasingly expensive; and lost their main competitive advantage - the low price (PODBEREZKIN AND PODBEREZKINA, 2015).

The development of road, and in particular railway technologies and the transformation of political structures between Europe and Asia will allow the creation of a new silk road. Even if inland transport (for the time being) is more expensive than maritime transport, the New Silk Road can bring significant benefits: it would take only about two weeks and China's dependence on maritime transport would decrease (SARVARI AND SZEIDOVITZ, 2016). Here, it is important to note that the "New Silk Road Economic Belt', 'One Belt, One Road', and 'Belt and Road Initiative' have the same meaning in this paper.

The New Silk Road concept has been China's greatest economic effort ever, with the main objective of stimulating economic development in Asia, Europe and Africa. The concept would affect 64% of the world's population (4.4 billion people) and would include 30% of the world's GDP (21 trillion dollars) (CASARINI, 2016; HUANG, 2016). While infrastructure development is at the centre of the agenda, it is also a non-negligible objective to achieve a barrier-free (duty-free) trade between Eurasian countries; and to provide different financial support to underdeveloped regions and countries. However, the One Belt, One Road Initiative faces many obstacles and barriers, including the conflict between different political views, and the question of the financial viability of cross-border projects (Huang, 2016).

In addition the well-marketable and communicable principles and priorities (e.g. openness, cooperation), the specific objectives of the New Silk Road Initiative are as follows: (1) the internationalization of the Chinese yuan (similar to the dollar); (2) efficient use of foreign exchange reserves (restoring balance); (3) reduction of production overcapacity in China; and (4) develop the western provinces of China (CHAISSE AND MATSUSHITA, 2018; YU, 2017).

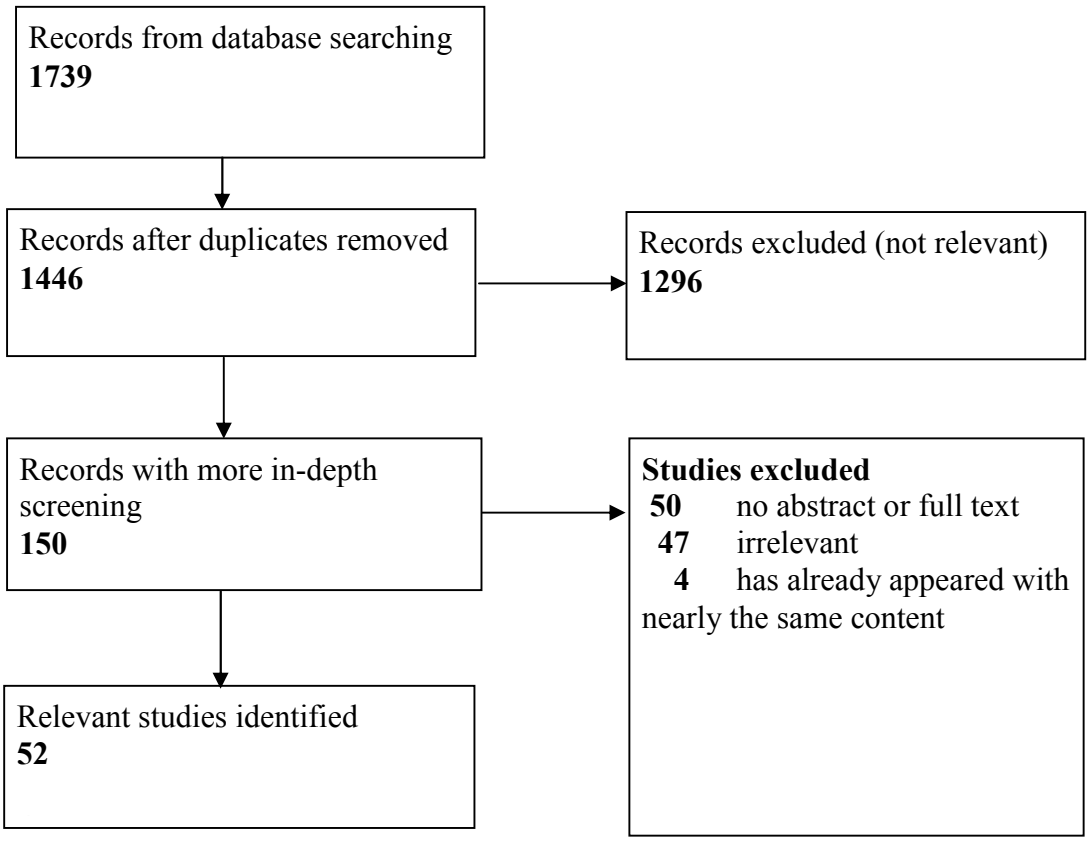
International reactions to the initiative were rather mixed. Some of the experts compare it to the Marshall Plan - which was launched in the aftermath of World War II -, while others do not regard this concept as an aid but rather as an international economic cooperation (HUANG, 2016). However, the fact is that China's New Silk Road goes far beyond the Marshall Plan. While the Marshall Plan was limited to the European region, China's plan is globally oriented: it covers 60 countries across Asia, the Middle East, Europe and Africa; and thus potentially has even greater international impacts (YU, 2017). In addition, the One Belt, One Road initiative can be considered more ambitious, as it can become the largest project of global industrialization ever designed for the Eurasian region (FARDELLA AND PRODI, 2017).

MATERIAL AND METHOD

In our study to achieve our goal, we made a systematic literature review related to the New Silk Road. Potential sources were identified using the most important databases (Scopus, JSTOR, ProQuest, ScienceDirect, ANU Library and EconStor), using English phrases "New Silk Road" and "China new economic belt". During the search, these terms had to appear in the title, abstract or keywords of the sources. The process of multi-circuit filtering is as follows.

In the first search - taking into account all the databases - 1,739 studies were primarily selected. After the removal of duplications, 1,446 studies remained that could potentially contain relevant results for our subject. We used the Covidence online platform to filter out the remaining duplicates and to include only the most important articles in the final analysis. The screening and identification process is illustrated in Figure 1. After removing duplications, the authors evaluated each article independently, and then discussed those studies where the authors had different opinions during a personal meeting. All this resulted in the "exclusion" of 1.296 articles. The remaining 150 articles were repeatedly evaluated based on the full text review by all the authors independently. In this last phase, a subgroup of 49 articles has been identified that really dealt with the New Silk Road concept. All studies for which the full text was unavailable, which were only partially focused on the topic covered, and publications that had already appeared in the same form in the past were excluded. The final list contains 49 relevant publications. Only 17 publications were used in this study due to the specificity of the topic (investigated only the possible routes) and the content requirements.

Figure 1: Illustration of the process of the systematic literature review



RESULTS

It is evident from the literature that trade between Asia and Europe by rail accounts for between 3% and 3.5% of total trade. It follows that 95-96% of trade between the two continents is carried out on sea, with only 1% of the goods being carried by airplanes. There is no chance for regular and economical truck transportation on transcontinental roads in good condition, so only railways can provide a real alternative to the sea. The question is whether land corridors can only play a complementary or fully substitute role (ERDŐSI, 2015).

As the literature reviewed suggests, currently there are two main routes connecting Asia with Europe: the Trans-Siberian railway and the Second or New Eurasian Continental Bridge (ERDŐSI, 2015). One of the oldest railway routes, the Trans-Siberian railway, operates regular freight between China and Europe (China – Russia – Belarus - Poland - Germany) (Bulis et al., 2014). Hungary joins the Trans-Siberian railway line on the Ukrainian border (Záhony) (BAJOR AND ERDŐSI, 2013). In order to increase international transit through Russia - which generates revenue for Moscow -, the electrification of the entire length of the railway line has been accomplished (ERDŐSI, 2015). There are nine major newly built railway lines between Asia and Europe (*Table 1*), the first was built in 2011, the latest in 2015.

Table 1: New railway lines connecting China to Europe

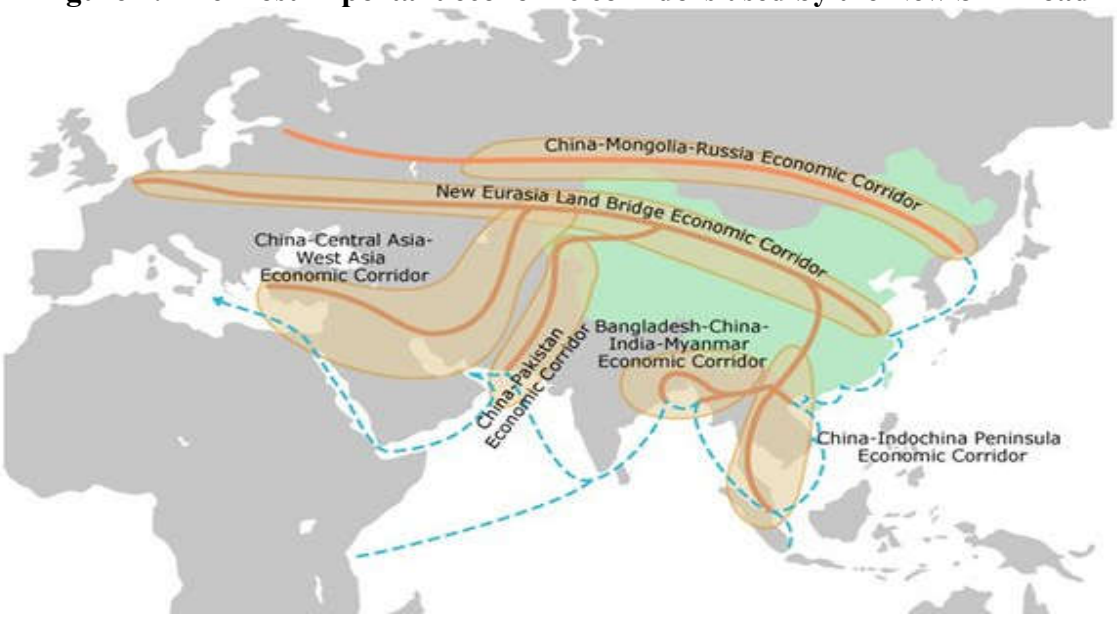
Name	***Route***	***Distance (km)***	***Duration (day)***	***Start***	***Frequency***	***Goods***
Yuxinou	Chongqing-Duisburg	11 179	16	July 2011	3x/week	IT products
Hanxinou	Wuhan-Mělník//Pardubice	10 863	16	Oct. 2012	2-3x/week	Electronic products, building materials
Sumanou	Sozhou-Warsaw	11 200	18	Nov. 2012	6-8x/week	IT products, household goods
Rongou	Chengdu- Łodź	9 826	10,5	April 2013	1x/week	IT products, clothes
Zhengou	Zhengzhou - Hamburg	10 214	19-20	July 2013	1x/week	Consumer products
Yixinou	Yiwu-Madrid	13 052	21	Nov. 2014	3x until now	Mixed goods
Hexinou	Hefei-Hamburg	11 000	15	June 2014	2x/month	Electronic products
Xiangou	Changsha-Duisburg/ Moscow/Tashkent	11 808	18	Oct. 2014	Every 10 day	Tea, porcelain, car parts

Haou	Harbin-Moszkva/Hamburg	9 820	15	June 2015	1x/week	Car parts, clothes

Source: Edited based on LI ET AL. (2018)

Literature also shows that the exact routes of the New Silk Road Initiative have not yet been fully defined, but will consist of several land and sea transport routes that will stimulate trade and economic development (FALLON, 2015). The mainland Silk Road is mainly directed to Central Asia and Europe, while the Maritime Silk Road mainly covers the countries of Southeast, South and North Asia (YU, 2017). The conception is focusing on six economic corridors (*Figure 2*) (CASARINI, 2016; FUNG ET AL., 2018).

Figure 2: The most important economic corridors used by the New Silk Road



Source: HKTDC Research (2018)

According to the majority of the literature, the New Silk Road would consist of three general land routes geographically (see, for example LEE ET AL., 2015; PODBEREZKIN & PODBEREZKINA, 2015). The first route (Northern Route) is from China to Central Asia and Russia, the second route (Central Route) would run through Central and West Asia to the Persian Gulf, the Mediterranean, and Central-Eastern Europe, and the third route (Southern Route) would run through Southeast and South Asia to the Indian Ocean. On the one hand, the Sea Silk Road would start from the coasts of China through the South China Sea to the Indian Ocean to Africa and Europe, on the other hand from the Chinese coastal ports through the South China Sea to the Pacific Ocean.

CONCLUSIONS

As described above, the Central Route would affect Central-Eastern Europe. In recent years, Chinese investment activity has been continuously increasing in the region. For example, by the end of 2014 a large number of different Chinese companies have invested in the Czech Republic, or even the growth of Chinese equity investments (FDI) in Hungary.

The investment of Chinese capital into the port of Piraeus in Greece began in 2009, when the Chinese state-owned company, China Ocean Shipping Company (COSCO), received a 35-years license. The radical expansion of the Piraeus shipping hub will allow the port to compete not only with other ports in the Mediterranean but also with northern European ports (e.g. Amsterdam, Hamburg). Thanks to the success of port developments, China has announced that it will build a high-speed railway from Piraeus to Budapest via Skopje and Belgrade. This would be implemented and operated by the Chinese state-owned China Communications Construction Company (CCCC) in a consortium with China Railway International, supported by the Chinese Export-Import Bank. The total length of the Budapest-Belgrade railway would be 350 km: 184 km on the Serbian side and 166 km on the Hungarian side (VAN DER PUTTEN & MEIJNDERS, 2015). Most of the V4 foreign trade (both export and import) has been flowing through decades on the northern Belgian, Dutch and German megacities, thanks to the high quality and reliability of the services, which have overridden the distance factor in transport decisions. However, the Budapest-Belgrade railway line may place emphasis on the port of Piraeus. For both Hungary and China, the New Silk Road can result in more and cheaper products thanks to the development of efficient transport networks. Thanks to the modernization of the railway line, Hungary can become a kind of "logistics distribution center".

The development of new rail links can bring benefits to most of the V4 countries. Certain industries, such as the automotive industry and the electronics industry, will be better off than other industries thanks to the higher value to weight ratio. The development of railways will have a greater impact on these sectors; and those whose export and import composition is particularly affected by these products (FARDELLA & PRODI, 2017).

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THE POSITION OF THE EU ORGANIC LABEL AMONG HUNGARIAN CONSUMERS - FACTORS OF AWARENESS AND REGULAR SHOPPING

ZALÁN MÁRK MARÓ – LILI JANTYIK – ÁRON TÖRÖK

Corvinus University of Budapest
Department of Agricultural Economics and Rural Development
1093 Budapest Fővám tér 8.
zalan.maro@uni-corvinus.hu

ABSTRACT
The European Union's Common Agricultural Policy (CAP) has undergone many reforms and - over the past decades - has reached a level where food security issues are basic criteria for the European food production. From the beginning of the 1990s, the EU has been trying to reinforce this positive overall impression with quality systems which are regulated at the Community level. Basically, European decision-makers regard two areas as being of paramount importance: geographical indication and organic food. Each system has separate certifications and labels to help consumers make their decisions. Despite the fact that these products are also important factors of EU trade policy and in the case of geographical indications in Hungary, there has been a separate Origin Protection Program, the relationship between Central and Eastern Europe consumers with this system is a rather undiscovered area. That's why the aim of this study is to investigate the awareness of the Hungarian consumers about the EU organic label and the factors that determine the awareness of the EU organic logo and the regular purchases. Not surprisingly, the awareness of the EU organic label and is still low despite the growing tendency in the recent years. The survey conducted in Hungary is based on a sample with 1,019 consumers. The online consumer survey was implemented during the second half of 2017. Results show that among the European food quality labels the organic label is one of the most recognized ones in Hungary, but its average awareness is still very low: less than every fourth Hungarian consumer knows what this label is for. The awareness of the EU organic logo is mainly determined by the sex (male), diet (fish consumption, (ovo)-vegetarian) and the place of purchase (alternative routes and internet). Regarding regular purchases, trust in the label and the system is crucial next to the age (younger ones), and purchase (supermarket). Therefore, in order to increase the sales of products with EU organic label, it is essential to sell bio food more widely, which will enable consumers to know more about organic products and the EU organic logo; as well as the application of a proper marketing strategy by companies to reach their potential target group, mainly the younger consumers. In any case, the future goal is to raise the awareness of bio and other quality systems (e.g. GI) products because the higher level of comsumers' awareness and trust can lead to a higher level of consumer willingness to pay. And this results in mutual benefit for both producers and consumers.

Keywords: organic, label, consumers

INTRODUCTION

In response to the health and environmental impacts of pesticides, genetically modified organisms and various food safety scandals, the demand for bio-based foods has grown spectacularly in recent decades. The supply side also adapts to the new needs of consumers, but the increasingly long supply chains and information asymmetries make it difficult for consumers to make decisions. The labels on the food packaging have become inevitable in the food sector, which can reduce information asymmetry and allow consumers to make more informed food purchasing decisions.

Community regulation of bio products was born in 1991 in the European Union, and the current legislation has been in force since 2018. The essence of the regulation is that the EU organic label should be marked for all pre-packaged organic food that is intended to be a bio product.

In Hungary, two state-accredited certification bodies are involved in the verification of the EU bio-label authorization (Biokontroll Hungária Nonprofit Kft. and Hungária Öko Garancia Kft.). Both organizations have their own logo, so in practice - in the case of bio-based products of Hungarian origin - the EU and one of the Hungarian certification labels are simultaneously on the packaging of the bio food (*Figure 1*).

Figure 1: Organic labels in Hungary *Note: The EU bio logo and the logos of Biokontroll Hungária Nonprofit Kft. and Hungária Öko Garancia Kft* Source: Commission Regulation No 271/2010 and websites of Hungarian certification bodies

In Hungary, the proportion of bio-areas is very low compared to the EU average and occupies only the 20th place among the 28 Member States of the European Union. Furthermore, the consumption of organic products is also very low (*Figure 2*), totalling EUR 3.04/person /year, whereas the European average is EUR 50.12/ person/year.

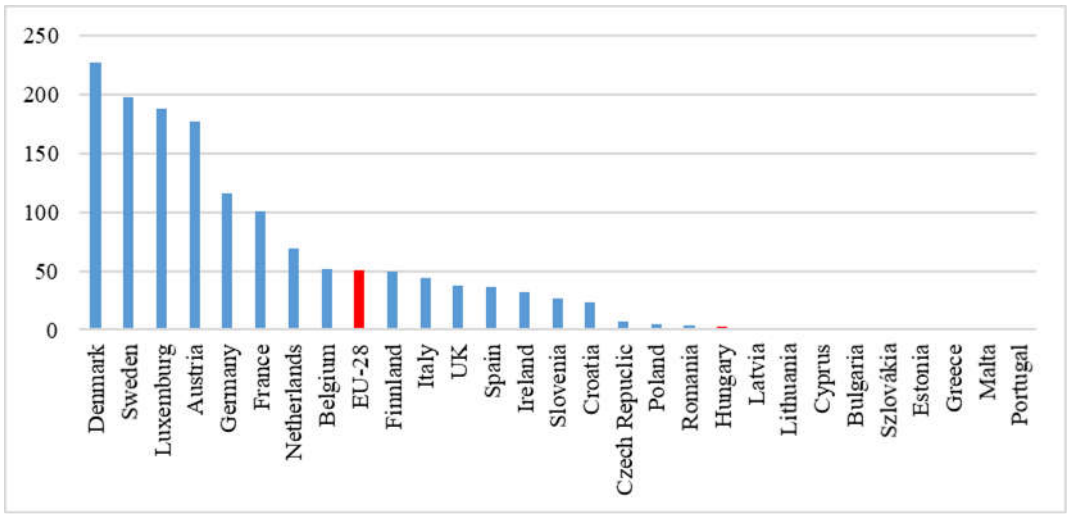

Figure 2: The consumption of organic food per country in the EU (EUR/person/year), 2016 based on FiBL (2019) data

In Hungarian-language literature, there are not many articles on this topic. Most of the articles are related to health-conscious nutrition (e.g. GÁL ET AL., 2017; MALOTA ET AL., 2019), and to the marketing opportunities of organic labels as food quality markers (among others: KISS ET AL., 2016).

JANSSEN AND HAMM (2012) investigated the awareness of the EU bio label besides some national certifications. The research shows that the awareness of the EU organic label is the highest in Italy (nearly 80%) and the lowest in the UK (around 10%). In six countries (Estonia, France, Germany, Italy, Poland and the UK), ZANDER (2014) also investigated the awareness of the EU bio logo. The results show that the logo's awareness is low and

that only 15% of the respondents knew the meaning of the logo. Binary logistic regression showed that the label knowledge is higher for consumers who regularly buy organic food.

One of the most most often examined criteria is the role of gender, and the vast majority of research results confirm that basically women prefer food from organic farming (KOIVISTO ET AL., 2003; STOBBELAAR ET AL., 2007; etc.). There were contradictory results in the literature regarding age. Some research has found older age groups more susceptible to buying organic products (RODDY ET AL., 1996; SCHIFFERSTEIN AND OUDE OPHUIS, 1998); however, recent results have shown that younger generations are more likely to buy organic products (MAGNUSSON ET AL., 2001).

Overall, it can be stated that there are great differences between the socio-demographic and economic characteristics of bio-products, both in space and in time. After a targeted review of previous literature, it can be generally stated that organic products are basically preferred by women, families, people living in the city and those who have higher incomes.

MATERIAL AND METHOD

The data used in the study was acquired in the second half of 2017, within the framework of an international research (in addition to Hungary in six other European countries) by the Strength2Food H2020.

Table 1 summarizes the most important characteristics of respondents. Regarding representativeness, it can be said that the sample is almost representative in terms of gender and age, while in the case of the place of residence the respondents from the village are under-represented, while in the case of the higher education, the highly-educated are overrepresented.

Table 1: The most important socio-demographic and economic characteristics of the respondents participating in the survey based on survey and KSH (2013)

	Survey	National census
All respondents/Population	1 019	9 937 628
Involved respondents	875	-
Gender		
Female (%)	50,03	52,52
Male (%)	49,97	47,48
Average age (year)	41,93	41,39
Location		
Rural area (%)	20,35	30,53
Urban medium town (%)	37,94	34,35
City (%)	41,71	35,13
Education		
Lower secondary/primary education or below (%)	2,63	31,73
Upper secondary education, university or college entrance qualification (e.g. A-levels, vocational certificate, technical diploma,) (%)	55,89	51,31
Bachelor's degree or equivalent level (%)	29,14	10,10
Master, Postgraduate or doctoral degree (%)	12,34	6,68
Average household income (HUF)	255 694	196 076
Number of children	0,66	1,07

RESULTS

According to preliminary expectations, nearly one quarter of respondents know the EU bio label. The respondents have a positive opinion on organics. On the 5-level Likert scale, the highest average was 4.02, indicating that respondents find the label reliable. This should be emphasized depending on whether (bio) foods are basically trusted products.

The majority of respondents (44%) ignored organic products when shopping because they did not have the opportunity to buy EU bio-certified food or they were available in a small selection in the store where they were purchasing food (*Table 7*). All this proves that in Hungary bio-products are currently in a small number of shops and are available in a relatively small range - compared to conventional foods. Respondents do not pay enough attention and time to study food labels.

Taking socio-demographic criteria into account, only the gender of the respondent was statistically significant in our survey, and we can conclude that men are more familiar with the label than women. The awareness of the label is determined by the purchase channel through which the consumer purchases the EU labelled organic product. The awareness of the label is higher of those consumers who buy food mainly in producer markets, department stores, biostores, online, directly from the producer, or through other alternative channels. The most important of these is the purchase through other alternative channels, as there is a five-fold increase in the chances of anyone aware the EU organic label. Interestingly, shopping at a bio store determines the awareness of the label to a lesser extent than buying online. Regular fish consumers are aware of the logo almost twice as much as those who do not eat fish, and (ovo)vegetarians are aware of the label better than non-ovo vegetarians (*Table 2*).

Table 2: Factors determining the awareness of the bio label odds ratios, z values in parentheses. The table contains only significant results.

EU organic label recognition	Gender	0,660
		(2,33)**
	Farmers' market	1,716
		(2,49)**
	Department store	1,661
		(2,14)**
	Organic store	2,678
		(2,76)***
	Online	3,021
		(2,68)***
	Directly from the producer	2,059
		(2,66)***
	Other alternative	5,316
		(2,50)**
	Eating fish	1,772
		(2,81)***
	Eating meat products	0,408
		(2,34)**
	Eating eggs	0,496
		(1,73)*

Significance levels: * p<0,1; ** p<0,05; *** p<0,01

The viability of the EU organic label is mainly determined by how often consumers are willing to buy such labelled products (*Table 3*). Among the socio-demographic factors, only the respondent's age was statistically significant in the model. The older you are, the less likely you are to become a regular bio buyer. It can be concluded from the results that companies - that sell bio-products - have to target mainly younger generations. Shopping from supermarkets, discount stores, producer markets, hypermarkets, and directly from the producers are the most important factors. If a consumer trusts in EU bio-certification, there is a 6.7-fold greater chance of buying such a product on a regular basis than if he had reservations about the label. In this case, the diet has no statistically significant role.

Table 3: Factors determining regular purchases. Odds ratios, z values in parentheses. The table contains only significant results.

Regular buyer	Age	0,964 (2,02)**
	Supermarket	5,899 (2,82)***
	Discount	4,589 (2,14)**
	Producer market	5,086 (2,85)***
	Department store	4,692 (2,39)**
	Hypermarket	4,084 (2,26)**
	Directly from the producer	4,272 (2,09)**
	Trust	6,692 (3,32)***

Significance levels: * p<0,1; ** p<0,05; *** p<0,01

CONCLUSIONS

The awareness of the EU organic label in Hungary is relatively low, but there is an increasing trend and has been approaching the EU average in recent years. Overall nowadays, the awareness of the EU labeled organic food is the highest of those consumers who buy food in alternative ways - not in supermarkets and hypermarkets. Regular customers of such products are mostly younger men who trust better in the quality systems.

In Hungary the consumption of organic food is likely to increase if consumers have access to these products in a wider range and through more sales channels. All this is confirmed by the fact that respondents do not buy bio labeled products because they do not have access to these products during their food purchases. In any case, the future goal is to raise the awareness of bio products and the knowledge of the European quality system, because we could achieve a higher consumption by building consumer trust.

ACKNOWLEDGEMENTS

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THE EFFECT OF FERTILIZATION ON THE YIELD COMPONENTS OF WINTER WHEAT

PÉTER JAKAB, ÁGNES JUSZTIN, ANITA BARANYI, MARGIT SZÉL HÓDINÉ

University of Szeged, Faculty of Agriculture, Hódmezővásárhely, Hungary

jakab.peter@mgk.u-szeged.hu

ABSTRACT
We investigated the effect of fertilization on the yield components of winter wheat in the crop-year 2016/2017. The experiment was set up in three replications on the area of the SZTE Tangazdaság Ltd. in Hódmezővásárhely. The soil was meadow soil. The forecrop was sunflower. Six fertilizer treatments were used besides the control: N80PK30, N100PK30, N130PK30, N150PK30, N170PK0 and N170PK50 kg/ha active ingredients. Experimental results were processed using single factor ANOVA.
The number of spikes/m^2 was 564.67 in the control treatment. In the N100PK30 and N130PK30 treatments we measured significantly higher values of 567.67 and 677.33 spikes/m^2. The number of kernels per spike was 36.5 in the non-fertilized parcels. We reached the highest value of 43.77 kernels in the N130PK30 treatment. The difference was not significant. The thousand kernel weight changed slightly due to the fertilization. We measured 31.08 g in the control treatment. We got the maximum value of 32.71 g in the N130PK30 treatment. The difference was not statistically justified. Our scientific results showed, that the N130PK30 kg/ha fertilizer level was the optimum for the winter wheat in 2016/2017.

Keywords: winter wheat, fertilization, yield components, thousand kernel weight, number of spikes

INTRODUCTION

The winter wheat has an important role in Hungarian crop production. The sowing area of wheat varies between 1.0-1.0 million ha. In Hungary, the average yield of winter wheat was 5.0-5.5 t/ha in the 1980's but nowadays the average yield varies between 3.0-5.0 t/ha depending on the climatic factors of crop-year (PEPÓ, 2007).
In sustainable cereal production, nutrient supply, fertilization is a key agrotechnical element (OEHL ET AL., 2004; KELLER ET AL., 2012).
In a favourable year, after good fore-crop the winter wheat reached the maximum yield in a N80PK30 treatment. The fertilization had different effects on the examined generative factors. The thousand seed weight did not change significantly, but the change of length of spike and number of spiklets under the influence of fertilization was significant (JAKAB ET AL., 2017).
Beside the yield amount, the nutrient supply had great effect on the different yield components of winter wheat. The higher N dosage increased the number of spikes and the number of grains per spike (RUZSÁNYI, 1985).
Macroelements play an important role in the formation of yield components of winter wheat (the number of shoots, the number of ears, the number of spikelets) (RAGASITS, 1998; PETRÓCZI ET AL., 2005; KRISTÓ ET AL., 2007, 2008).
There is a significant correlation between N supply and thousand seed weight. Fertilization had a significant effect on the length of spike, weight of spike and grain number of spike (LÖNHARDNÉ ET AL., 1995; JAKAB ET AL., 2016).

MATERIAL AND METHOD

The experiment was set up in three replications on the area of the SZTE Tangazdaság Ltd. The soil was meadow soil, which was nearly neutral (*Table 1*).

Table 1. Main properties of the experimental field area

pH (KCL)	P_2O_5 (mg/kg)	K_2O (mg/kg)	Humus (%)	Soil plasticity value (K_A)
7.16	335	619	3.38	48

Source: HL-LAB Ltd., 2016

The year 2016-2017 was unfavourable for winter wheat production. The amount of precipitation in the vegetative period of winter wheat was lower by 80.2 mm than the 50 years average. The distribution of precipitation was unfavourable (*Table 2*).
The experiment was set in three replications, organised as a random block in 2016. Beside the control, we applied six fertilizer treatments: N80PK30, N100PK30, N130PK30, N150PK30, N170PK0, N170PK50 kg/ha active ingredients. The forecrop was sunflower. The variety was Lucullus. The experimental data were analysed by single factor ANOVA.

Table 2. The distribution of precipitation in the vegetative period of winter wheat in 2016-2017

Month	Rainfall (mm)	50 years average rainfall (mm)	Difference (mm)
October	88.0	34.7	53.3
November	50.0	41.1	8.9
December	2.0	43.0	-41.0
January	20.0	30.6	-10.6
February	24.0	30.1	-6.1
March	11.0	29.8	-18.8
April	43.0	39.9	3.1
May	71.0	58.0	13.0
June	48.0	75.3	-27.3
July	4.0	58.7	-54.7
Total amount of rainfall (mm)	**361.0**	**441.0**	**-80.2**

Source: SZTE Tangazdaság Ltd.

RESULTS

We investigated the effect of fertilization on the yield components of winter wheat (the number of spikes/m^2, number of kernels per spike, and thousand kernel weight). Fertilization had different effects on the yield components of winter wheat. The number of spikes/m^2 was 564.67 in the control treatment. Under the influence of fertilization the values increased. The maximum values were 657.67 and 677.33 pieces in the N100PK30 and N130PK30 kg/ha treatments, respectively. These results were significantly higher compared to the control *(Figure 1)*.

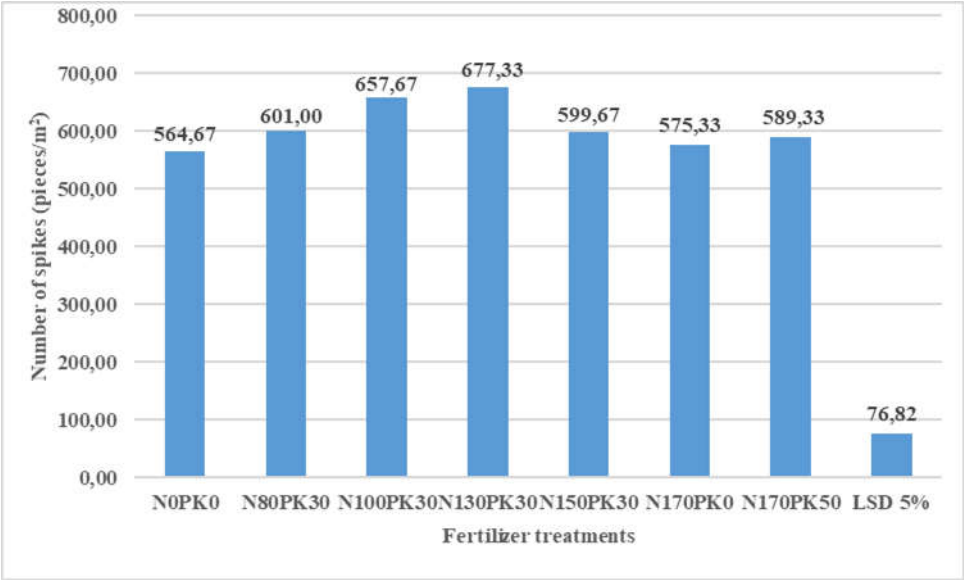

Figure 1. The effect of fertilization on the number of spikes/m^2 of winter wheat

The thousand kernel weight is highly dependent on the genetical background of the variety. However, the ecological and agrotechnical factors are able to influence this parameter. Among the agrotechnical factors, fertilization had the highest effect on this parameter. Our study proved that the thousand kernel weight is strongly dependent on the genotype. The thousand kernel weight was 31.8 g in the control treatment. Fertilization slightly increased this parameter, its effect was not significant. We measured the maximum value, 32.71 g, in the N130PK30 treatment (*Figure 2*).

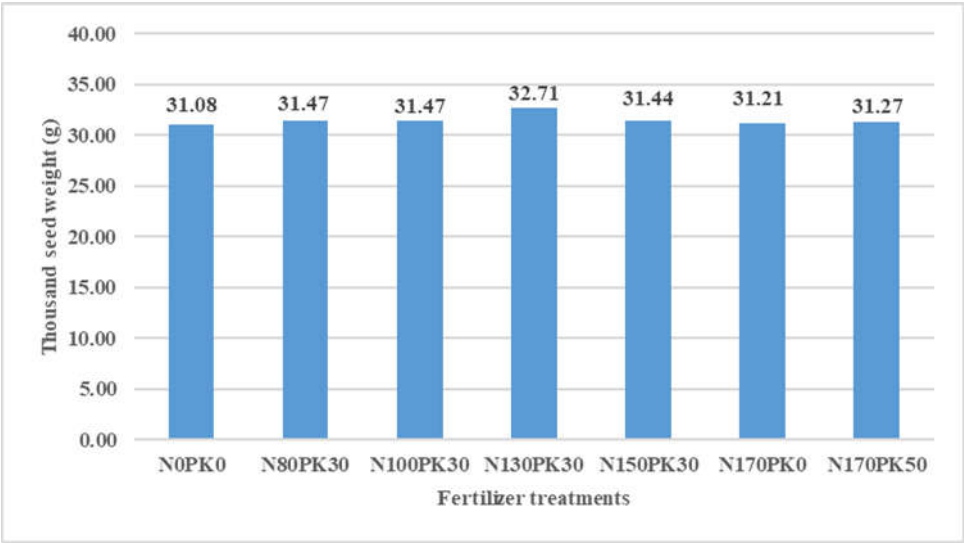

Figure 2. The effect of fertilization on the thousand kernel weight of winter wheat

The number of kernels per spike is also an important yield component. The fertilization can increase this yield component. In our experiment, the number of kernels per spike in the control treatment was the minimum, 36.50 pieces. Under the influence of fertilization, the values increased (40.8-43.77 pieces). The maximum value, 43.77 pieces was measured in the N130PK30 treatment, but the difference compared to the control was not statistically justified (*Figure 3*).

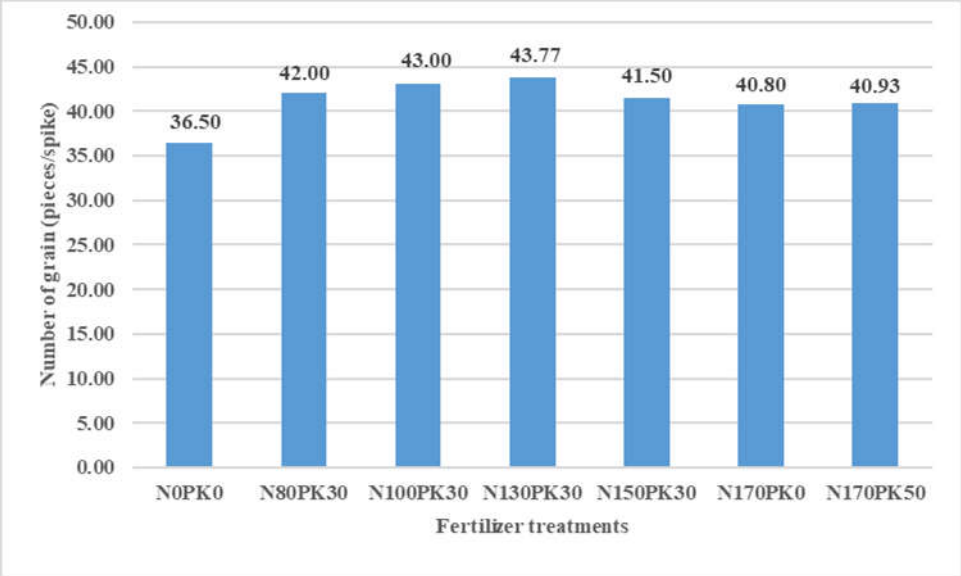

Figure 3. The effect of fertilization on the number kernels per spike of winter wheat

CONCLUSIONS

Nutrient supply has an important role in wheat production. Winter wheat is one of the best fertilizer-responding field crop. Weather conditions (mainly the amount and distribution pf rainfall) can modify the yield components of winter wheat. Fertilization had different effects on the examined generative factors. The thousand kernel weight and number of kernels per spike did not change significantly, but the change of the number of spikes/m^2 under the influence of fertilization was significant. We can conclude that concerning the yield components the moderate fertilizer dosage of N130PK30 was the most favourable fertilizer dosage in our experiment.

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EFFECTS OF DIFFERENT FERTILIZER DOSES ON THE YIELD AND SOME QUALITY PARAMETERS OF WINTER WHEAT

PÉTER JAKAB, NÓRA MASA, ANITA BARANYI, MARGIT SZÉL HÓDINÉ

University of Szeged, Faculty of Agriculture, Hódmezővásárhely, Hungary
jakab.peter@mgk.u-szeged.hu

ABSTRACT
The influence of different fertilizer doses on the yield and quality of winter wheat was studied on meadow soil in the crop-year 2016-2017 in Hódmezővásárhely. The experiment was set up on the area of the SZTE Tangazdaság Ltd, in three replications. The forecrop was sunflower. Six fertilizer setups were applied besides the control: N80PK30, N100PK30, N130PK30, N150PK30, N170PK0, and N170PK50 kg/ha active ingredients. The year 2016-2017 was unfavourable for winter wheat production. The amount of precipitation in the vegetative period of winter wheat was lower than the average. The obtained data were processed by single factor ANOVA. In the control treatment, the yield was 4.20 t/ha. The maximum yield of 5.60 t/ha was reached with N130PK30 kg/ha fertilizer treatment. The yield difference between the two treatments was statistically justified. The nutrient doses higher than N130PK30 did not increase the yield of wheat.
A crude protein content of 17.60% was measured in the N0PK0 treatment. The highest content of crude protein (18.70%) was in the N100PK30 and N130PK30 treatments. The Zeleny number was 70.40 ml in the control treatment. In the N130PK30 treatment, it reached the maximum value of 76.0 ml. In our experiment, the N130PK30 kg/ha fertilizer dose was the most favourable concerning the yield and quality parameters of the examined winter wheat variety.

Keywords: winter wheat, fertilization, yield, gluten content, crude protein content

INTRODUCTION

Cereals are the most important field crops in Hungary and also all over the world. Winter wheat has specific importance on most parts of the Earth, because its production is possible even in case of extreme soil and ecological conditions due to its extraordinary adapting ability (ZSOMBIK AND ERDŐS, 2014; SZILÁGYI, 2016).
The nutrient supply is only one of several factors of utilizing the genetic potential of wheat varieties (KRISTÓ ET AL., 2008; CZIMBALMOS ET AL., 2014, 2016).
Providing a balanced nutrient supply is essential, since it has a remarkable effect on the quality and the quantity of the yield, on the environment, and also on the effectiveness of production. (SÁRVÁRI, 1984; JAKAB ET AL., 2016; JAKAB ET AL., 2017).
The crop-year basically determined the dry matter production, assimilation area and yield of winter wheat; these effects were modified by fertilization. The effects of genotypes were moderated (PEPÓ, 2005).
The lower amount of winter wheat yields on average might have been caused by applying lower amounts of fertilisers. Consequently, fertilisation must be increased to have higher crop averages (KOMAREK, 2007, 2008).
Today the number of farmers using various soil bacterium preparations in addition to chemical fertilisation is growing.
There are different types of bacteria in these preparations, which can improve the nutrient supply of plant. When applying these products the amount of chemicals can be reduced and in this way we contribute to an environmentally friendly and economical production. The products improve the physical and chemical properties of the soil and maintain soil fertility. (MÁRTON AND DAODA, 2001; ÁRVAY, 2004; BÍRÓ, 2004; JAKAB ET AL., 2004; JAKAB, 2006a; JAKAB, 2006b; JAKAB, 2010).

The environmental components have great effect on the quality of winter wheat, but the wheats of different genotypes react differently to the environmental effects (PETERSON ET AL., 1998; KUTASY ET AL., 2005).
The yield and quality fluctuation between the years can be reduced by applying good varieties and professional agro-technical methods (KUTASY ÉS CSAJBÓK, 2001; GYŐRI, 2006; KRISTÓ ET AL., 2007; PEPÓ AND CSAJBÓK, 2014; ZSOMBIK AND SERES, 2018).
TANÁCS ET AL. (2000) studied the effect of fungicides and foliar fertilizers on the quality of winter wheat. They stated that the variety x fungicide treatments caused significant changes in the examined quality parameters (gluten content, falling number), but the effect of foliar fertilizers was lower.
In a dry year, the effect of fungicide treatments was not significant for the baking industry parameters such as wet and dry gluten content, and falling number (TANÁCS AND GERŐ, 2002).
TANÁCS ET AL. (1997) examined the effect of NPK fertilization on the amino acid composition of winter wheat grain yield. They found that the highest amino acid value was in N 180 kg /ha fertilizer dosage except for the ARG and HIS.
The fertilization had positive effect on the baking parameters of winter wheat. Among the macro-elements, the nitrogen had the highest effect on the quality parameters of winter wheat (JOLÁNKAI ET AL., 1990; RAGASITS AND SZABÓ, 1992; TANÁCS ET AL., 1993, TANÁCS, 2005).

MATERIAL AND METHOD

The experiment was carried out in three replications on the area of SZTE Tangazdaság Ltd. The soil was meadow soil. The soil analysis data showed, that it had good nitrogen and very good phosphorus and potassium content (*Table 1*).

Table 1. Main properties of the experimental field area

pH (KCL)	P_2O_5 (mg/kg)	K_2O (mg/kg)	Humus (%)	Soil plasticity value (K_A)
7.16	335	619	3.38	48

Source: HL-LAB Ltd., 2016

The year 2016-2017 was unfavourable for winter wheat production. The amount of precipitation in the vegetative period of winter wheat was lower than the average. The distribution of precipitation was unfavourable. The rainfall in November, April and May was more than the average, while in December, January, February, March, and June less rain fell compared to the average (*Table 2*).

Table 2. The distribution of precipitation in the vegetative period of winter wheat in 2016-2017

Month	Rainfall (mm)	50 years average rainfall (mm)	Difference (mm)
October	88.0	34.7	53.3
November	50.0	41.1	8.9
December	2.0	43.0	-41.0
January	20.0	30.6	-10.6
February	24.0	30.1	-6.1
March	11.0	29.8	-18.8

April	43.0	39.9	3.1
May	71.0	58.0	13.0
June	48.0	75.3	-27.3
July	4.0	58.7	-54.7
Total amount of rainfall (mm)	**361.0**	**441.0**	**-80.2**

Source: SZTE Tangazdaság Ltd.

The small-scale plough experiment was set in three replications, organised as a random block in 2016. Beside the control, we applied six fertilizer treatments: N80PK30, N100PK30, N130PK30, N150PK30, N170PK0, and N170PK50 kg/ha active ingredients. The forecrop was sunflower. The variety was Lucullus. We processed the obtained data by single factor ANOVA.

RESULTS

In the control treatment, the yield was 4.2 t/ha. Under the influence of fertilization, the yield increased (4.8-5.6 t/ha). We measured the maximum yield of 5.6 t/ha in N130PK30 treatment, which was significantly higher compared to the control. The higher fertilizer doses did not increase the yield compared to the N130PK30 dosage (*Figure 1*).

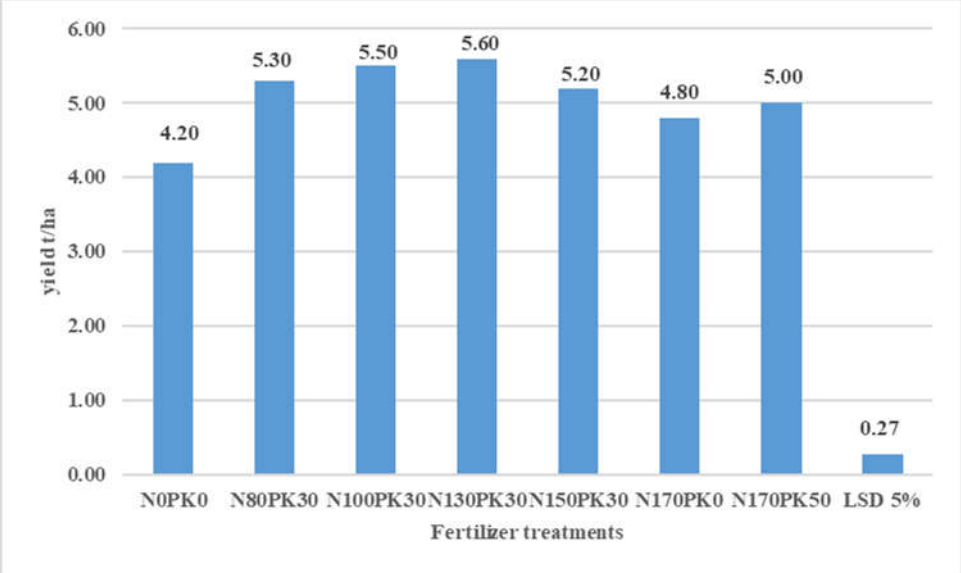

Figure 1. The effect of fertilization on the yield of winter wheat

We examined the effect of fertilization on the quality parameters (Zeleny number, crude protein content) of winter wheat. The Zeleny number in the control treatment was 70.4 ml. The maximum value was measured in the N130PK30 treatment, 76.0 ml. In the higher dose fertilizer treatments (N150PK30, N170PK0, N170PK50), we calculated less values (66.6-74.8 ml) compared to the N130PK30 treatment. Fertilization did not increase this quality parameter significantly (*Figure 2*).

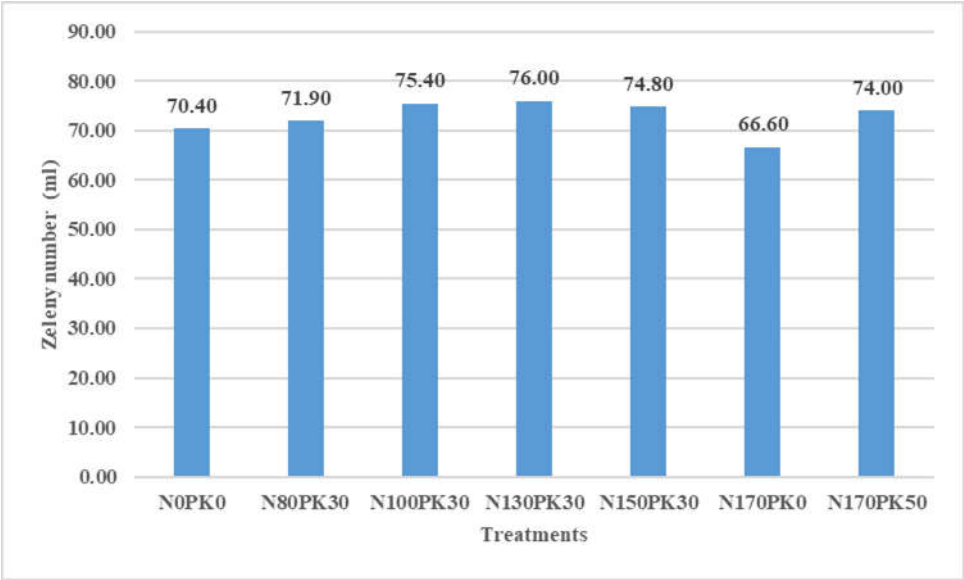

Figure 2. The effect of fertilization on the Zeleny number of winter wheat

The crude protein content of wheat grain was 17.6% in the control treatment. In most cases, we got higher results compared to the control, except for the N170PK0 treatment. The highest value was 18.7% in the N100PK30 and N130PK30 treatments. The increase was not significant compared to the control results (*Figure 3*).

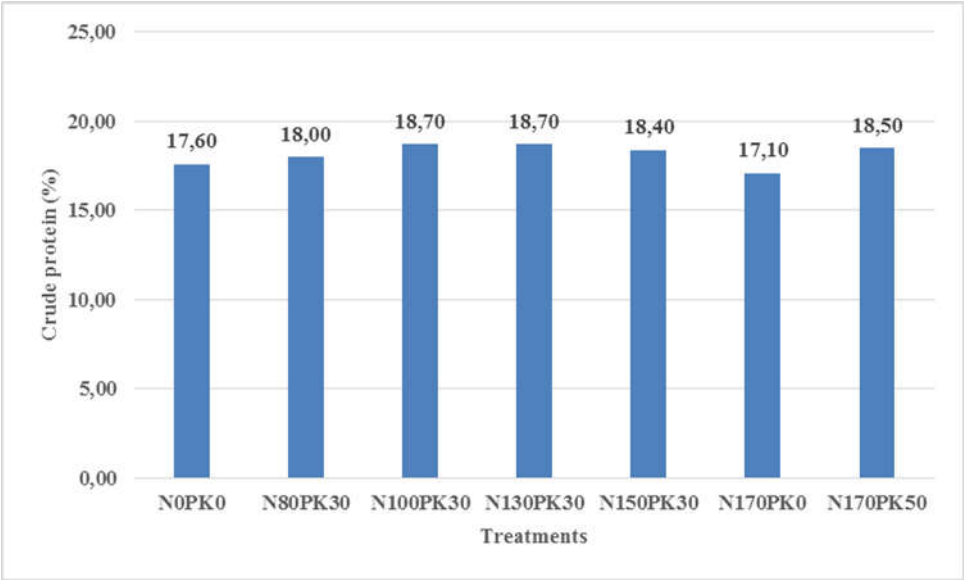

Figure 3. The effect of fertilization on the crude protein content of winter wheat

CONCLUSIONS

The year 2016-2017 was drier and warmer than the 50 years average. Therefore, the yield of the control plots was moderate: 4.2 t/ha. Compared to this result, we measured higher results in fertilizer treatments. We got the highest yield of 5.60 t/ha in the N130PK30 fertilizer treatment. Fertilization had a positive effect on the quality parameters of winter wheat. The Zeleny number and crude protein content reached the maximum values in N130PK30 treatment, but the increase was not statistically justified. We can conclude that

concerning the yield amount and the quality parameters of grain, the moderate fertilizer dosage of N130PK30 was the most favourable fertilizer dosage in our experiment.

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